Mechanical World

AND ENGINEERING RECORD

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Cushioning in all three planes

The great success of Cushyfoot anti-vibration mountings is due to a unique combination of features.

With different degrees of flexibility in vertical, transverse and longitudinal directions, they can be arranged to give exactly the right amount of cushioning in every plane.

The very high deflections available isolate low frequency vibration and reduce foundation costs for large machines by obviating inertia blocks of concrete, or permitting the use of much smaller blocks. Bolting down is not necessary when friction locating pads are used in conjunction with the mountings.

For unit loads up to 3,500 lb., the Cushyfoot is compact, robust and designed so that the rubber elements never lose their resiliency and are protected from oil and mechanical damage.

Please write for brochure illustrating the application of Cushyfoot mountings to diesel generators, power presses, screens, compressors and many other machines causing vibration or requiring protection from it.

METALASTIK

Nuclear Marine Propulsion

WITHIN a very few years the nuclear powered sea-going commercial vessel will be an established reality. Such vessels are now building, and as far as performance goes there is the practical example of the U.S. Navy's nuclear powered submarines. Last month the Admiralty received eight different proposals for commercial nuclear propulsion and set up a body to examine them. The proposals varied a good deal, but all appeared to offer solid bases for successful and economical working.

British experience with land based nuclear power stations is a secure jumping off ground for making marine power plants using similar systems. It also reduces the degree of uncertainty in using hitherto untried systems. Some of the British nuclear engineering groups have been giving close attention to an inevitable future requirement—that of the relatively small generating station, at any rate very much smaller than those, like Calder Hall and Chapelcross, that have been completed. Small stations will be required in many parts of the world, and the output required is about what would be needed for a large sea-going vessel. It is not surprising, therefore, to find that some of the groups which have been designing small land nuclear plants have embodied the same basic elements in their proposed marine installations. This is in parallel with established practice with other forms of power generation, for nowadays marine plant differs from land plant only in relatively minor details.

The reactors put forward for marine propulsion cover most of the possible types, and include low pressure and high pressure gas-cooled types, and those using boiling water, heavy water, pressurized water, and the sort which has a liquid plastic or organic material as a moderator. Uranium enriched in some degree is the fuel mostly specified, but plutonium is a popular alternative. The marked contrasts are in price, perhaps in size (although there are obvious limits to this) and in details. Some of the prices vary from £750,000 to as much as £3,000,000, but of course first cost is not so important as total annual cost within the lifetime of the particular ship. Nuclear plants are necessarily more costly than conventional plants, but their total running cost is not more, and will certainly become less with experience. Very important, of course, is the long time that a nuclear powered vessel can keep at sea, and the further fact that time in port is not extended by having to take on fuel. Weights are not at all excessive, especially when present-day bunkers (not required with nuclear propulsion) are considered. In the matter of detail there are, in the proposals, quite special things like new designs of fuel element, and contrasts in materials used, i.e. as between what are still regarded as special materials on the one hand and conventional materials like mild steel (one of the reactors proposed would be built largely of mild steel). Delivery times, even at this early stage, seem to be quite confidently put at 30 to 36 months, and in some cases the prices are firm too. Altogether, there is an air of confidence which can only come from practical experience, and which augers well for speedy adoption of the nuclear principle in ship propulsion.

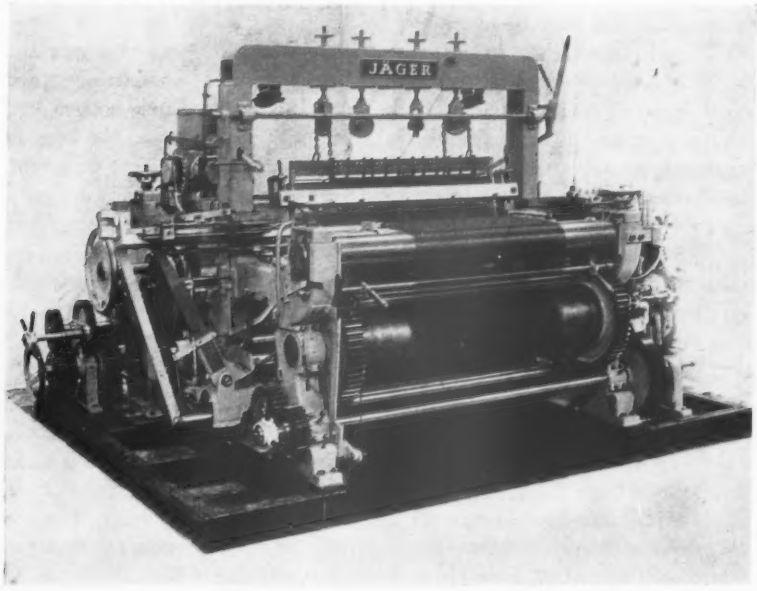
Just what is the ideal in marine propulsion? It cannot be much more than ample power for greatly extended cruising at a rate which is not a burden by comparison with other ship charges. It is clear that all this can now be provided for large ships, but only time, learning by experience, and further development work, will show whether the same advantages can be given to smaller vessels. If there should be a limiting size for the power plant it might well decide the size of ocean-going vessels, for nuclear propulsion is the only source in the long term future when coal and oil are no more.

LOG SHEET

Wire Weaving Loom

The loom in the accompanying illustration is a modern underpick loom capable of weaving wire up to 0·220 in. dia and down to 0·020 in. dia. It is equipped with a positive let-off of special arrangement with variable gear ratios to give high accuracy of mesh in weaving over the whole of its productive range. The beating device or sleigh is so arranged that it is lowered away from the cloth during both the forward and backward movements in order to prevent any abrasion or damage of the warp wires during weaving. The cloth tension is accurately maintained by a device which automatically re-loads itself after each wire is inserted when the cloth moves forward. Cloth can be woven as plain weave i.e. over and under one, or for varying twill weaves e.g. over two under two. The loom is arranged if necessary to give a second beat in the forward position so that the wire is finally placed after the warp wires are crossed, insuring greater accuracy. This loom is of the most modern design and produces high quality weaving from all metals in the medium and heavier ranges of wire cloth. It is one of a large number of looms of all types installed at the Greenwich Works of G. A. Harvey & Company (London) Limited who can supply wire cloth from $\frac{3}{4}$ in. to 0·001 in. dia. The loom in the picture is mounted on a special base, on which it was transported for demonstration at the Engineering and Marine Exhibition.

Various weaves can be made on this loom using wire of from 0·001 to $\frac{1}{4}$ in. dia and in all metals



The "Dracone's" Pump

The flexible oil barge, the *Dracone*, 100 ft long and 5 ft dia and made from strong woven nylon fabric coated with synthetic rubbers, was towed on two occasions with 10,000 gal of kerosene from the Esso Refinery, Fawley, on Southampton Water to the Esso Depot at Newport, Isle of Wight, by a small 45 hp launch at a speed of five knots for the ten mile journey.

For emptying and filling the Dracone one of the newly developed Goodyear high speed portable pump sets was carried in the towing launch. It was easily lifted, with its prime mover, into and out of the launch. It was an A-12 pump, driven by a Petter PC2 diesel engine, and is probably the first positive-displacement rubber-to-metal type pump to operate at 3,000 rpm, delivering the high specific output necessary for this task, and having compact size, small weight, powerful suction and economy of operation. It emptied the 10,000 gal of kerosene from the *Dracone* in 65 min.

MERL becomes NEL

In future the Mechanical Engineering Research Laboratory at East Kilbride, near Glasgow, will be known as the National Engineering Laboratory. This is because the Council for Scientific and Industrial Research considers it desirable to emphasize the national character of the laboratory which is part of the D.S.I.R. organization and is financed from public funds. It does not imply any changes in the field covered by the laboratory, which will continue to be concerned with problems of mechanical engineering.

The council has also decided to set up a steering committee to look after the programme of the laboratory. As a result of a recent review of the functions and activities of the laboratory, the council is convinced that, between the proper and reasonable activities of the universities and technical colleges on the one hand and research associations and private and nationalized industry on the other, there is an important place for a national establishment for research in mechanical engineering, mainly supported by public funds.

The object of the laboratory is to establish the principles and extend the knowledge of mechanical engineering science so as to provide industry with the information it requires for the solution of its own particular problems. In order, therefore, that its work may be focussed on practical objectives of real value to industry (which may involve basic or applied research or, in suitable cases, development work), the council has decided that the planning of the laboratory's activities and the selection of research projects can best be under the control of a small body with a measure of executive authority.

The new steering committee will be under the chairmanship of Vice-Admiral Sir Frank Mason, K.C.B., M.I.Mech.E., M.I.Mar.E., who is a member of the Research Council and chairman of the outgoing Mechanical Engineering Research Board. Admiral Mason, who was Engineer-in-Chief of the Fleet until his retirement from the Royal Navy in 1957, is now a director of Metal Industries Limited and of H. W. Kearns & Company Limited. The members of the committee will be Professor O. A. Saunders, Professor of Mechanical Engineering at the Imperial College of Science and Technology, University of London,

Mr. Norman Elce, Director and Chief Mechanical Engineer of Metropolitan-Vickers Electrical Company Limited, Dr. D. G. Sopwith, Director of the Mechanical Engineering Research Laboratory, and Dr. C. M. Cawley, Director of Stations and Grants Divisions of the D.S.I.R.

Dr. S. P. Hutton and Mr. F. D. Penny have been appointed Deputy Directors.

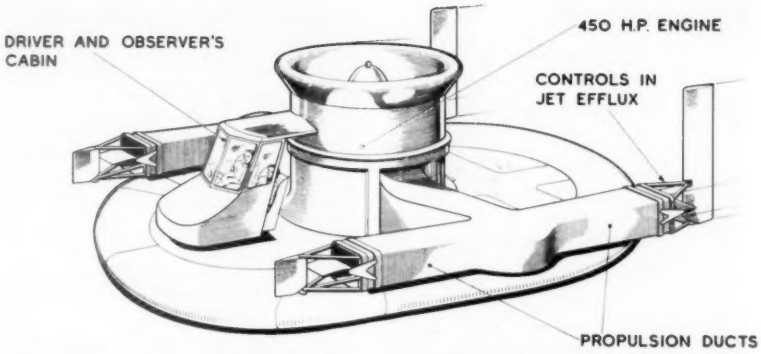
Hovercraft

The prototype of the hovercraft is an all-British saucer-shaped machine which is supported on a "cushion" of air and skims across the surface of the sea. An early practical application of the hovercraft principle may be a cross-channel passenger and vehicle ferry, but the first operational craft likely to be built will probably weigh less than 100 tons. The efficiency of the hovercraft, however, increases with its size and secret experiments which have been carried out in the Isle of Wight show that in the future craft weighing thousands of tons and travelling at speeds of about 100 knots are possible. An important feature of the hovercraft is that it can be loaded and serviced on land, making harbours and expensive port facilities unnecessary. This means that it could operate in many parts of the world at present inaccessible to modern transport.

The hovercraft principle was invented by Mr. C. S. Cockerell who started work on the project in 1953. His experiments on this entirely new method of obtaining lift proved the possibility of supporting a craft on a cushion of air. Tests with models showed that it was feasible to build a full-sized craft and that, by bleeding off some of the air to suitable nozzles, it could be propelled and controlled horizontally.

As a result of Mr. Cockerell's work, it was decided to build a man-carrying experimental craft, and the National Research Development Corporation, through its subsidiary company, Hovercraft Development Limited, placed a contract with Saunders-Roe Limited of Cowes to undertake the research, design and development of such a craft.

The first hovercraft made by Saunders-Roe has been designated the SR N1. It is thirty feet long and twenty-four feet wide and is powered by an Alvis Leonides 450 h.p. engine which drives a ducted fan to provide the supply of air for lift and propulsion. It has a crew of two and will be "flown" by Peter Lamb, Saunders-Roe test pilot.



The prototype of the Cockerill hovercraft made by Saunders-Roe has an Alvis Leonides engine. It is in effect a large fan. The fan blades are of laminated wood and hand carved

The hovercraft is not an aircraft, as it does not rely on wings and forward speed for lift; neither is it a ship, as it operates clear of the water. Both in conception and operation it comes between the two. It fills the gap between aircraft flying fast with comparatively small payloads, and large capacity ships travelling at slower speeds.

Hand-carved wooden fan blades, designed and built by The Airscrew Company & Jicwood Limited, of Weybridge, Surrey, provide the lifting force. The four blades are constructed from laminations of aerograde mahogany, glued with waterproof synthetic resin and covered with a special plastic. The leading edges are protected by a metal sheath.

Accurate balance of the impeller, was obtained by control of the shaped dimensions of the blades within the drawing tolerances. No artificial means of balance was used.

There are also pre-rotational vanes constructed of resin-bonded 0·04 in. thick birch veneers, with grain direction arranged to give the optimum strength characteristics. The vanes are built into a rigid central blanking which carries the nose faring.

The pre-rotational vanes and the blanking assembly is dowelled and bonded at the blade tips to a section of ducting also made of wood. The duct is double-skinned of birch ply and mounted on plywood rings. The entire assembly is finished with aluminium bituminous paint.

The inventor of the hovercraft principle, Mr. Christopher S. Cockerell is forty-eight and was educated at Gresham's School and Cambridge University. He has worked with W. H. Allen & Sons Limited of Bedford and subsequently undertook radio research work at Cambridge University. Before the war he joined Marconi Wireless Telegraph Company Limited, where he was responsible for the development of airborne communications equipment and for a device used for plotting enemy radar stations. He is the son of Sir Sidney Cockerell who was the curator of the Fitzwilliam Museum, Cambridge. Mr. Cockerell is also the owner of a boatbuilding business on the Broads at Somerleyton in Suffolk.

FLUON FOR PUMP BELLOWS.—This single bellows pump unit for handling corrosive liquids was made by Crane Packing Limited, Slough. It incorporates a bellows and other components made from Fluon p.t.f.e. Polytetrafluoroethylene made by Imperial Chemical Industries Limited is called "Fluon". It first appeared in 1948 as a granular powder which cost £5 per lb. Since March 1956 the price has been about £2 per lb, and recently this price has been reduced by 13%. Fluon is a remarkable material. Its ability to withstand chemical attack and its good insulating qualities have made it attractive for the chemical and electrical industries, and it has a wider working range than any other plastics material. It has notable "non-sticking" properties

First 200 MW Turbo-alternator

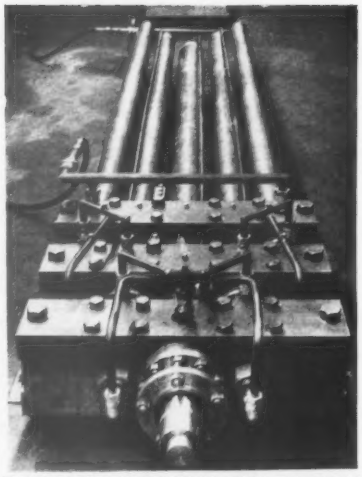
The first 200,000 kW, 3,000 rpm English Electric reheat steam turbine for the British Central Electricity Generating Board has successfully undergone works tests preparatory to being installed in High Marnham Power Station.

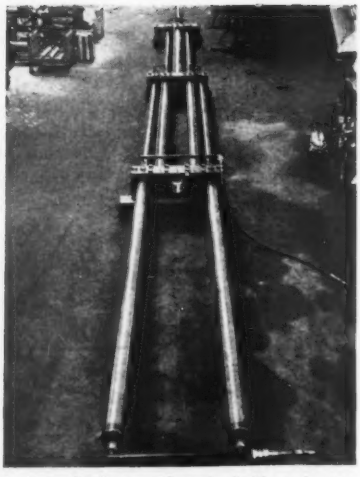
High Marnham Power Station is situated in an agricultural belt in the East Midlands on the west bank of the river Trent and is within easy access of the East Midlands coalfields and close to the main railway line linking Chesterfield and Mansfield with Lincoln. This 1000 MW station, when completed, will contain five 200,000 kW English Electric turbo-alternator sets and will be the largest not only in Britain, but also in Europe. English Electric are also supplying five 415V switch and control gear units to High Marnham. Delivery of these units has already begun and will continue in phase with the commissioning of the main turbo-alternator sets.

The new turbine is the largest ever to leave the Rugby Works of The English Electric Company Limited. It is also the first tandem 200,000 kW steam turbine to be manufactured in Britain. The turbine is typical of the most advanced designs now in course of manufacture at the company's Rugby Works, the largest turbines on order (the largest turbines yet to be built in Europe) being the two 275,000 kW sets for the Blyth B Power Station of the C.E.G.B.

At High Marnham the five turbo-alternator units are arranged in line along the station at 120 ft centres. The total weight of one turbo-alternator unit is 1,450 tons, the maximum lift being that of the alternator stator at 168 tons approximately.

With a running speed of 3,000 rpm, the turbine is of the horizontal three-cylinder design having a double casing impulse type high-pressure cylinder. Steam enters the turbine stop valve at 2,350 psig 1,050° F—the highest steam conditions so far attained in any British power station. The steam from the high-pressure turbine exhaust is taken to the reheater and then returned to the intermediate-pressure cylinder at 475 psig and 1,000° F. The intermediate-pressure cylinder is combined with one section of the three-flow low-pressure cylinder and has impulse stages up to the point of exhaust to the low-pressure stages.





TELESCOPIC HYDRAULIC RAM ASSEMBLY.—The hydraulic 3-stage telescopic double acting ram assembly seen here consists of five cylinders designed to operate at constant speed and pressure on each extension on the pull and push action, with a closed length of 14 ft 9 in. and an open length of 44 ft 9 in., maximum working pressure 2,000 psi, push capacity 20 tons, pull capacity 9 tons. It was supplied to the order of Hudswell Clarke & Co. Limited, for the marshalling of railway wag ons and was made by Spenborough Engineering Company Limited, Heckmondwike, Yorks

Approximately one-third of the steam remaining after bleeding passes through the combined low-pressure portion, and the remaining two thirds is led through two overhead interconnecting pipes to the double-flow, low-pressure cylinder. The three-flow low-pressure cylinder exhausts to a single-shell condenser, the vacuum at the most economical and continuous maximum rating being 28.7 in. Hg (Bar. 30 in.) when using cooling water at 60° F.

The condensing plant includes a single-shell condenser, two full-duty extraction pumps, three 50% duty rotary Leblanc type main air pumps and two quick-starting exhausters.

There is a six-stage feed water system giving a maximum temperature of 460° F at continuous maximum rating. Feed water de-aeration is supplied with provision for off-load de-aeration.

High Marnham's Alternator

The alternator is of the latest hydrogen cooled design employing direct cooling of the stator and rotor conductors at a rated gas pressure of 30 psig. The hydrogen coolers are arranged longitudinally in the upper part of the stator frame and circulation of the hydrogen through the machine and coolers by means of an axial flow blower. Generation is at 16,500 volts with rated phase current of 7,780 A at 0·9 power factor.

The exciters comprise a main and pilot unit arranged back to back on the same shaft and driven through gearing from the tail end of the alternator. They are totally enclosed and ventilated on the closed circuit principle, the air being circulated through the machines and coolers by means of a direct coupled fan. The maximum output of the main exciter is 3,000 A at a rated voltage of 520 volts, the speed of the exciters being 750 rpm.

Torsionmeter for Tyre Factory

A torsionmeter, for measuring the torque developed in a rotating shaft, has been commissioned at the new Dunlop tyre factory at Amiens, France, where nearly 5,000 tyres a day are produced. Suppliers were Siemens Edison Swan Limited.

This instrument is part of a tyre life-testing plant which incorporates a "rotating road". A similar arrangement is already in use at Fort Dunlop, Birmingham, England.

Fitted integral with a length of shaft which is part of the drive between the motor and wheel, the torque instrument affords a practical method of measuring the power being developed in the shaft. By means of a varying airgap in a small differential transformer the average angle of twist over a certain length of shaft is measured and, in conjunction with the speed and a constant obtained by previous calibration, the horsepower is com-

puted in a simple way to an accuracy within 1%.

The integral torsionmeter is intended for high speed work and the Amiens instrument is designed for use up to 1,000 rpm. The readings are recorded on a unit located on an upper platform away from the shaft.

Though introduced a quarter of a century ago for marine use, the torsionmeter has subsequently found many industrial applications including aircraft jet and internal combustion engine testing, wind tunnel motor rotation measurement, tests on gas turbines and helicopter rotor performance trials.

Alloy Steel Rolling Plant

The stainless and alloy steel rolling plant at Samuel Fox & Co. Limited, Stocksbridge, a subsidiary of The United Steel Companies Limited, is to be modernized by widening the cold rolling mill to produce sheets up to 72 in. wide, and by the installation of a new mill for rolling sheets and light plates up to the same width. When the scheme is complete the plant will be able to make stainless and alloy sheets up to 30 ft long, 6 ft wide and $\frac{3}{4}$ in. thick, with a maximum weight of 3000 lb. Initial output will be about 11,000 tons a year—half in plate and half in sheet.

The new hot mill is being largely engineered at the Stocksbridge works and will incorporate a number of novel features. As a two-high mill with an 83 in. barrel length, it will be capable of rolling 5 in.-thick slabs into plates and sheets in single thicknesses from $\frac{3}{4}$ in. to $\frac{1}{8}$ in. thick. The mill can also be set up as a four-high unit, with work rolls of about 15 in. dia, and a second set of driving pinions will then be brought into use. In that form, and after doubling, hot rolled sheets from $\frac{1}{8}$ in. to 0·050 in. thick will be produced either for direct sale or for subsequent cold rolling.

A new walking beam reheating furnace is being installed to serve the hot mill. Equipped with fully-automatic control, the withdrawal gear will enable either a slab or semi-rolled plate to be handled by push-button. The discharge table of the furnace will be fitted with a manipulating table for turning and aligning the plates or sheets before delivery to the mill. Special breast rollers will carry the sheets fully into the pass line of the small work rolls.

Safety Seal

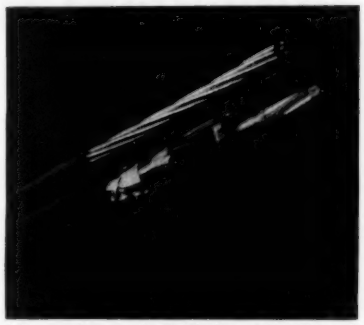
A scheme for approving equipment, products and appliances as "safe" has been launched by the British Safety Council, 60 Westbourne Grove, London W2. Under the scheme a manufacturer can submit his product for testing, which is carried out by selected independent laboratories. If the product meets the standards of safety set by the Council, the manufacturer is awarded the certificate and seal of approval. Either of these may be used in advertising and promotional material and may be stamped on the product. Periodically the Council will buy items of the approved article from a retailer and test them to ensure that the standards are constantly maintained.

The safety seal of the British Safety Council will appear on or in connexion with appliances and products which conform to the Council's standards of safety

Self-supporting Overhead Line

A self-supporting overhead telephone line with cable and suspension strand integrally sheathed has been commissioned on the 15-mile Ramsgate-Canterbury (Kent) railway line. This type of cable is new to British Railways and replaces existing open wire lines on part of the Southern Region's own telephone system. Contractors for supply, erection and jointing are Siemens Edison Swan Limited.

The design is often referrred to as the "cottage loaf" type owing to its unusual cross section. Three sizes of cable are used: 16-pair, 20-pair and 28-pair. The 0·050 in. 40 lb/mile conductors are polythene insulated and laid up in star quad formation, the requisite number of quads being stranded together and a screening applied overall. The cable and suspension strand are integral in the overall pvc sheath. Some of the cable pairs are loaded at 2,000 yd intervals to maintain the signal to a level such that these pairs can form part of a much longer circuit.



Self-supporting overhead telephone line with cable and suspension strand integrally sheathed in p.v.c.

Channel Tunnel Survey

Since work on the Channel Tunnel ceased in 1880 the only activity on the project has been a seismic and sonar investigation made in 1958 by an American company, the result of which confirmed a French survey made in the last century. A further and possibly final survey is now in hand for the Channel Study Group, and is being made by George Wimpey & Company Limited who are using a method they have perfected and employed in several places in the world. It does not involve the usual and very costly drilling platform but uses instead a shallow draft vessel fitted with mooring winches and a boring platform cantilevered over the side. It is proposed to remove 6 in. cores of undisturbed rock for laboratory analysis. Other tests will include pumping water into the borehole to test absorption at various levels, and also logging by the Schlumberger method, much used in oil well drilling, which involves lowering special equipment down the borehole to record the various properties of the soil. After the tests, the boreholes will be sealed with cement grout.

Under the Channel are three layers of chalk beneath which lies gault and then greensand filled with water which exerts an upward pressure. Only the lowest layer of chalk is impermeable and the object of the survey is to find a route where this layer of chalk is fault-free and thick enough to ensure safe tunnelling.

Operation of Industrial Refrigeration Plant

Preparation and planned procedure to ensure safe and efficient working

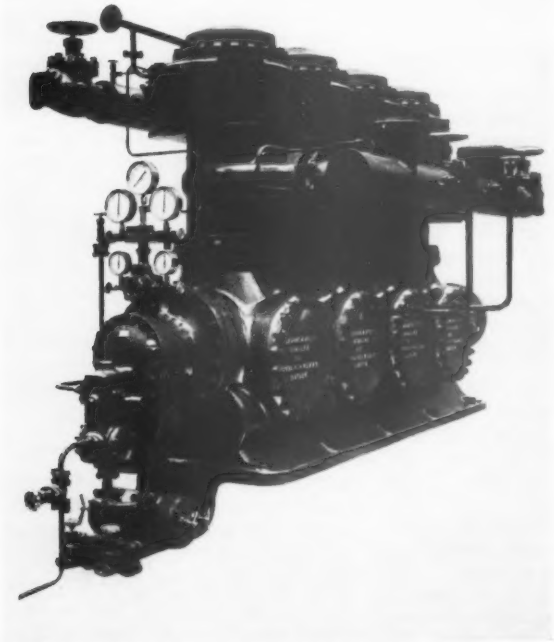
By Wm. LAMB, M.I.Mar.E., M.Inst.F.

INDUSTRIES such as those engaged in chemical textile and rayon manufacture and dyeing require low temperatures for process work. Especially is this so in the manufacture of artificial silk and this industry affords a useful basis for the consideration of the machinery employed and the practical methods of operation.

It is common practice to use the ammonia or carbon dioxide systems. They are similar in operation but one has advantages which are not at the moment of importance. The absorption and cold air systems can be dealt with later, as unless the process demands both, they are not greatly in favour in industry.

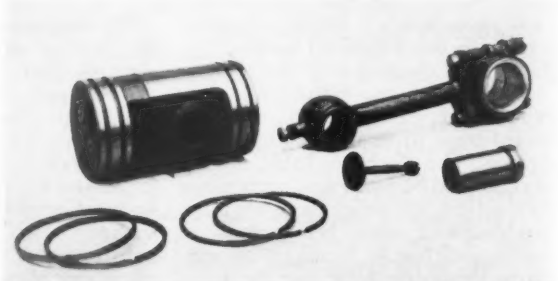
The cycle of operations in the ammonia refrigerator consists of compression, condensation and expansion. By means of a compressor the pressure of the ammonia is raised, and after discharge to the condenser the ammonia is evaporated when heat is transferred to the ammonia from the brine or cooling agent which circulates throughout the pipe system which distributes the coolant to the process departments.

The engineer-in-charge requires to be conversant with each component part and its function. Beginning with the evaporator this is a tank containing a series of coils immersed in the brine, which usually is diluted calcium chloride of the required density, each coil possessing an inlet and outlet valve by which the flow of ammonia gas can be regulated apart from the main regulating valve. Ammonia under pressure is peculiar in behaviour in that if the coils are connected to one header it does not necessarily follow that each coil will be served with the same amount of gas. The distribution depends to some extent upon the brine circulation surrounding the coils. The criterion in assessing the work done by each individual coil is the degree of frost upon the surface. After operating for some time the coils become coated in this way. Should a coil be free from frost, it is evident that ammonia gas is not passing through the pipe in sufficient quantity to promote freezing action. When coils are connected to one header, two or three auxiliary regulating or expansion valves are sometimes required, apart from the control valve of each coil, to obtain an equal distribution of gas. The expansion valve or regulator, serves the purpose of controlling the ammonia gas when entering the evaporator. Should this valve not be adjusted to accommodate the amount of gas coming from the



Ammonia compressor. Rated capacity 300 tons refrigeration at 300 rpm, motor-driven. This machine has a special divided suction manifold so that two cylinders can be used at one suction pressure and two at another.

Compressor safety head and discharge valve unit. The discharge valve units are held in place and the safety head in its position on the ground seating in the cylinder by heavy section springs. In the event of liquid ammonia or oil entering the cylinder the complete head lifts



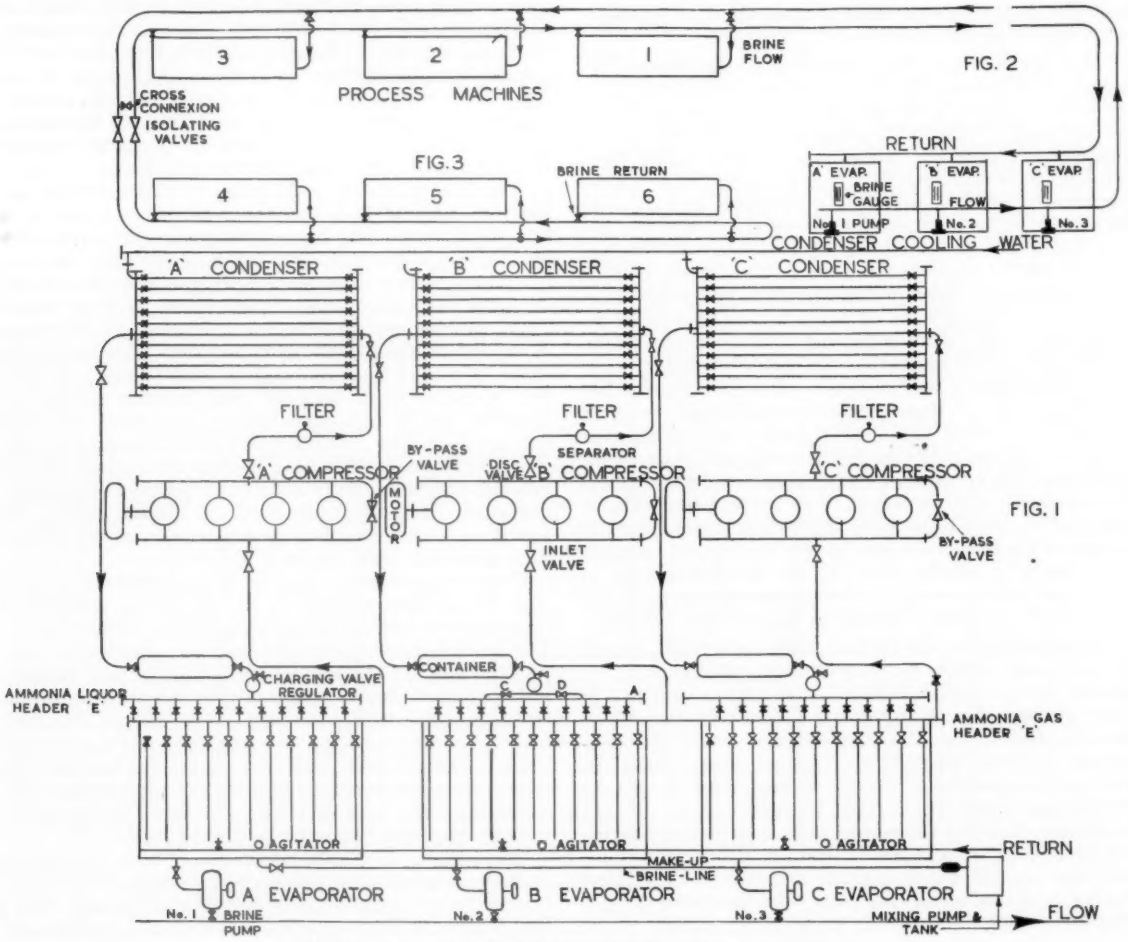
Compressor piston with rings, connecting rod and gudgeon pin

compressor the machine may be overloaded or underloaded and refrigeration impaired. It follows that the heat extracted from the process plant by the cooling agent can influence the performance to a greater or lesser degree, depending obviously upon the number of machines in service or the amount of heat to be extracted.

It is not usually the practice to reduce the pressure within the evaporator sufficiently to obtain a partial vacuum, the reason being that any source of leakage would cause the liquid surrounding the pipes or coils to enter the system. Control of the evaporator pressure during plant operation can reduce the need for purging the plant of impurities. A series of coils are immersed in the tank which contains the cooling agent; the brine ought to cover the top row of pipes. Should this be neglected, the atmosphere being at a higher temperature than the brine allows a heat transfer to occur which inevitably can reduce the plant efficiency. Ammonia gas passes from the regulating valve to the distributing header A inside the insulated chamber B, Fig. 1. The auxiliary regulating valves C and D are situated beneath the header A through which the gas is distributed to each coil, and the inlet valves of the coils can be adjusted for the purpose previously stated. From the header the gas passes to the bottom row of the pipe coils and flows to the header E. During this passage heat is transferred from the brine to the ammonia gas which receives the heat, and the temperature of the top header is higher than the bottom header. The heat absorbed by the ammonia is removed by the compressor.

In putting the plant in operation the circulating brine pumps are started up, but first it is ascertained that all essential valves are open on the brine distributing system. As the pumps are usually below the brine level in the tank it may not be necessary to prime them, but it is good practice to open the air cock at the top of the body for the purpose of expelling air, then putting each pump in motion as required.

In Fig. 2 is illustrated a typical lay-out of three evaporators with the brine circulating system, and the position of the brine sight gauge glasses which indicate the brine levels within the evaporator tanks, thus providing visual means of proper regulation of the level in each tank. This usually can be carried out by adjusting the discharge valve and of the brine flow from each tank, or the return valves of brine pipe line flowing into the evaporator tank, whichever may be convenient. The work of refrigeration is regulated by the number of machines using brine. Thus if three refrigerating units represent 100% output, obviously, if this can be reduced, one machine remains in continuous service whilst the second refrigerator is employed only to



Figs. 1-3.—Layout of a typical industrial refrigeration plant for process work

maintain the temperature of the brine flow at the lowest temperature essential for production. When this is reached one machine only is essential until the temperature is increased.

The brine circulating system is controlled by sectional valves and by-passing connections whereby sections of the distributing mains can be taken out of service for repairs, or if they are not required, thus reducing the load upon the compressors. As the coolant is expensive, when repairs are to be executed the brine is drained into drums and returned to the system by the brine mixing pump indicated in Fig. 1. Losses occur in the amount of brine within the system, also the density of the brine may vary, and to maintain the correct quantity of this liquid and also to rectify the density it is essential that additional calcium chloride be prepared and mixed whereby the evaporators operate at the correct working level and the top rows of tubes be covered, hence the mixing tank can be used for this purpose and make up brine supplied.

Illustrated in Fig. 3, is a typical lay-out of the distributing brine mains with flow and return pipes indicated, also by-pass connexions, and the inlet and outlet supply pipes to each machine used for process purposes. Suitable indicating and recording instruments are usually installed in the refrigerating machine room. Thus the plant is controlled and the performance recorded. Log sheets are used to enter the data necessary to compute the efficiency.

After compression of the ammonia by the compressor, the gas is discharged in the condenser, which may be of the double pipe type or atmospheric type. In the former the gas passes through the outer annulus formed by two pipes one within the other, and cooling water flows through the inside pipe. This type is not in favour due to the necessity of disconnecting pipe bends and cleaning the inside of the centre pipes by means of wire brushes and rods. In the atmospheric condenser the cooling water flows downwards from a trough over the outside of the pipework conveying the ammonia gas. Heat transfer in this component is of equal importance as in the evaporator, and a dirty condenser can restrict the output of the plant in so much that during hot weather, when loading conditions can be severe, if a condenser is not maintained in a clean condition additional power is necessary to effect the heat transfer and reduce the ammonia temperature sufficiently for liquefaction of the gas. It is also necessary for each pipe to receive a sufficient flow of water over the whole of its cooling area. This is achieved by ensuring an even distribution from the water trough above the condenser. As this usually can be taken from rivers or nearby streams, the impurities such as weeds and broken twigs foul the system the necessity for some form of screen or strainer is therefore obvious.

The compressor may be horizontal or vertical, steam, oil, or motor driven, the purpose being to compress the gas and extract the latent heat. There may be one, two or four cylinders depending on the output required. When the gas passes from the evaporator it enters the compressor cylinder through the suction valves above the piston and cylinder if of the vertical type. It is then compressed and discharged through valves to the condenser. Leaving the compressor, and before entering the condenser, the gas passes through a separator which entrains any oil which may accumulate in the system from the lubricated moving parts in contact with the gas. The oil-bearing liquor which settles at the bottom of the vessel is then passed through settling compartments in the filter and the clean oil is returned to the crank case sump.

The gas leaving the condenser is stored in liquid form in a vertical or horizontal cylinder prior to passing through the expansion valve.

Preparing plant for service

It is obvious that prior to placing the refrigerating installation in operation, various tests are essential to ensure safety, reliability in performance, and to discover defects. Invariably the condenser requires a pressure test to locate possible leaks, the evaporator a vacuum test for the same reason, the compressor requires operating without ammonia gas in the system to ensure that no moving parts become unduly heated, and also to check upon the security of bolted parts. This operation is performed first, and after a short running period the main bearings, bottom ends and other parts are examined for overheating and slackness. Valves can also be adjusted. Both suction and delivery valves are closed during this operation and the valve chest covers removed. The oil is then drained from the system, strained and replaced after the crankcase has been cleaned with cloth, not waste, as particles adhere to castings and enter the oil system tending to damage the helical pump or collect near the entrance of the internal lubricating holes. The gland of the main shaft can be made of white metal or similar material, which reduces friction. Care is essential in its adjustment so that the pressure upon the shaft is correct for gas tightness. It is usual to allow oil to run freely from the gland during the running period, recovering the oil in some receptacle and slowly to tighten the gland until a few drips proceed from the space between the gland and shaft, leaving an internal film.

Assuming that the installation is motor driven and that the compressor is in order and ready for service, a test for vacuum may be carried out on the evaporator and this should be sustained for at least twenty to thirty minutes at approximately 25 in. Hg vacuum. Should any decrease take place and air percolate through bolted parts, an examination is necessary to ascertain the cause. A lighted candle placed near the faulty part reveals the location of the leak. Sometimes soap solution is used, but a candle is to be preferred. Various defects are revealed during this test. Often joints have not been tightened equally on each bolt and an opening results. The joints must also be perfectly clean and entered securely within the spigot and socket parts of the register. Obviously the expansion valve is closed during this operation, and the suction valve when the correct amount of vacuum has been attained.

If the evaporator is in order it is possible to proceed with the condenser and by means of the compressor raise pressure within, usually twice the working pressure. The procedure for ascertaining leaks from this component with air pressure is not difficult and requires little comment beyond the fact that the pressure should be sustained for thirty minutes. To obtain the air supply for applying pressure to the condenser, the suction side headers can be dismantled and during the test the pipe system from the discharge valve of the compressor to the expansion valve and including the liquid container are tested whilst this operation is carried out.

This agitator assists the circulation of brine throughout each evaporator and prevents static pockets of the liquid. It consists of a motor driven impeller suspended from a long length of shaft near the bottom of the evaporator tank, which when revolving creates a flow of the liquid

within the tank. Before filling with brine this device is examined, especially the impeller; should this come apart during operation difficulties arise when effecting a repair.

To fill the evaporator the mixing tank is employed and the large pieces of calcium chloride mixed with water to make a solution which is tested for density. When this is in order the mixing pump is started and liquid drawn from the tank to discharge into the evaporator. If three evaporators are prepared for service, the amount of brine must be sufficient to accommodate the brine circulating system and enough to cover all top rows of the coils. The brine level can then be indicated by a pointer on the gauge denoting the safe working level.

To charge the system with ammonia from bottles a connexion is made between the bottle and the expansion valve pipe, before the valve. This operation requires care: in the first instance, when the cap of the bottle has been taken apart it is necessary to examine the valve for defects before the connexion is made secure. As the bottle is lying tilted for drainage purposes it is positioned for the connecting pipe to be secured, and connected to the charging valve usually under the expansion valve. No valves are opened until all joints are tightened and the bottle valve is slowly opened until the pipe is under pressure and no leaks are apparent; the charging valve can then be opened carefully. Obviously, as the condenser is not under pressure the gas should flow until such time as the compressor is working. This is decided when the bottles do not empty within a reasonable period. Meanwhile the condenser is again examined for ammonia leaks, located by burning sulphur upon a piece of wood which, when passed over the suspected parts, produces a white cloud of vapour. To rid the system of any entrained air, purifying valves are fitted at the top of each coil and connexion can be made to them by means of a flexible hose, the open end of which is led into a pail of water. When the purifying valve is opened, should air pass there is little noise, but ammonia produces a chattering sound, thus proving that the air has passed. The operations mentioned can be carried out when the system is receiving ammonia; eventually it is necessary to use the compressor for the purpose of admitting a full charge of the gas for the function to be performed.

Placing the system in operation

When preparing to operate plant containing ammonia gas there are precautions to be taken, as in steam raising installations, which may appear of minor importance at the moment but which later may become disastrous through neglect.

Checking the control valve positions each time plant that is placed in commission becomes a routine habit which is amply rewarded by smooth operation and the minimum of breakdowns or failures. Obviously, the first act is to ascertain that the correct valves are open and the correct valves closed. In our example it is the brine circulating system which is first placed in operation and all the appropriate valves are opened before starting the pumps—this means all discharge and suction valves; and when the brine is returning to the evaporator tanks and the pressure within the mains is applied, with the correct brine level in each tank, the compressor then is similarly prepared for operation.

It is usually the practice to circulate the gas, i.e., the gas is drawn from the suction header, through the suction valves and discharged through the discharge valves into the discharge header from where a connecting valve and pipe returns it to the suction header, as illustrated. Before starting the compressor this valve is opened, but both suction and delivery main valves are closed. Invariably all valves on the condenser discharge line are open except the main discharge mentioned. All evaporator header and top and bottom interconnecting valves are open except the main suction valve and expansion valve. When the machine is running at speed the main discharge valve can be opened. It is important that gas be admitted slowly to bring the machine on load gradually. The suction valve is first carefully eased and then gradually opened full until gas is drawn from the evaporator. The expansion valve is also gradually opened and adjusted to suit the appearance of frost upon the cylinders. Once the correct position is found further adjustment is seldom necessary unless the plant loading varies. Charging is continued until the expansion valve

COMPRESSOR No 1					BRINE COOLING CIRCULATING PUMP		CONDENSER COOLING WATER		BRINE COOLING	
TIME	AMMONIA INLET PRESSURE PSI.	AMMONIA OUTLET PRESSURE PSI	AMMONIA INLET TEMP °F	AMMONIA OUTLET TEMP °F	TEMP °F ENTERING EVAPORATOR	TEMP °F LEAVING EVAPORATOR	TEMP °F ENTERING WATER	TEMP °F LEAVING WATER	TEMP °F FLOW	TEMP °F RETURN
12 MNIGHT										
1 A.M.										
2 "										
3 "										
4 "										
5 "										
6 "										
7 "										
8 "										
9 "										
10 "										
11 "										
12 NOON										
1 "										
2 "										
3 "										
4 "										
5 "										
6 "										
7 "										
8 "										
9 "										
10 "										
11 "										

BRINE FLOW METER READINGS			REMARKS
12 MIDNIGHT	FINISH		
12 MIDNIGHT	START		
DIFFERENCE			

Typical log sheet for an ammonia refrigerating plant

is approximately one quarter of a turn open and the system fully charged.

The intention at this stage is to reduce the brine temperature to within operational limits. The compressor is working, the brine circulating the evaporator, gas is extracting heat from the brine and the cooling water flowing around the condenser pipes is condensing the gas into liquor, which is stored in the container or pig.

When three or more units are operating in common the routine is complicated by the additional plant to be controlled. When shutting down the plant, or preparing parts for repairs and overhaul, and it is essential to remove ammonia in either gaseous or liquid form. There is danger in inhaling the gas and particular attention should be paid to pockets where liquor may collect.

Connexions are provided for extracting gas from the evaporator, the condenser, the crankcase and separator. These connexions on the evaporator are seldom used as repair here is infrequent, where it may occur is in the header valves or the valves of the outlet and inlet to the coils.

When the plant is out of service, pressure can arise within the evaporator due to heat in the brine absorbed from the atmosphere when no refrigeration is taking place: then it is essential to reduce this pressure by using cross connexions. The compressor is circulated and the connexion from the suction to discharge lines used as indicated in the illustration, the circulating valve not being used in this case. Similarly, when pumping out the crank case a connexion is provided. When pumping out the condenser the cross connexions are used.

Assuming that three units as described have been put in operation, the important things to examine are the circulation, the cycle of operations, and the temperatures of the brine flow and return.

Instruments are provided which indicate the pressures and temperatures in the evaporator and condenser. If the evaporator pressure increases so also does the condenser temperature, and the object is to maintain both within the operational limits. Undue rise in condenser pressure can be due to a dirty condenser or air within the system. To remedy the first defect is obvious, the second however can be rectified by purging each coil separately or by installing a purging apparatus which is automatic in operation and continually releases out air which may have passed into the system.

By careful adjustment of the distribution control valves the temperatures can be maintained and the plant operated at an economical load.

Co-operation between the process and the refrigerating departments invariably assists efficient operation in so much as due warning of increase or decrease of load prepares the operating engineer for making adjustments.

Any variation of load is discernible in the snow line. This is between the hot discharge side and the cold suction side of each cylinder where hot and cold meet. The snow line creeping either way gives warning of what is taking place regarding the loading and reference to the temperature recorder provides accurate information. On a change of load being absorbed the expansion valve is regulated accordingly and the subsequent movement of the snow line observed. Each machine requires its own setting and the expansion valves on one machine may be more open or closed than on another.

Hourly readings are taken of the evaporator pressure and temperature, also of the condenser pressure and temperature, the brine flow and return temperature, the cooling water inlet and outlet, all as indicated on the sample log sheet illustrated.

Acknowledgment is made to L. Sterne & Co. Limited, Glasgow, for illustrations.

Heavy Duty Contactor-starters

In common with all Crabtree control gear, the Type J-60 range of heavy-duty contactor-starters has been developed from a small number of standardized and interchangeable units which are mounted on single or two-unit backplates to give a wide choice of control. The same backplates will also accommodate built-in isolating switches and H.B.C. fuses. When used as a contactor on a.c. supplies of 415 V 50 cycles, the Type J-60 has a rating of 100 amp per phase for heating loads and 60 amp per phase for inductive loads. On the standard 415 V supply the direct-on starters are suitable for motors of up to 40 hp and the auto star-delta starters for motors of up to 70 hp. J. A. Crabtree & Company Limited, Lincoln Works, Walsall, Staffs, have introduced a number of features in the design of the Type J-60. The magnet system, for example, operates vertically, the motion being translated through 90° to give horizontal closing of the main contacts, nylon buffers being provided to absorb the shock of magnet closure. The moving contacts embody a patented damping device designed to ensure bounce duration of less than 1 millisec and auxiliary contacts, which are provided with silver tips, have a moving bearing of nylon to minimize wear. Nylon has also been employed for the plungers of the oil-tight push-button units. The 3-phase overload unit is of the compensated thermal type and is current-transformer operated. It is available in two sizes; 15 to 30 amp and 30 to 60 amp, and is adjustable on site for hand or automatic reset. The isolating switch, which is a triple-pole, double-break type, has a continuous rating of 100 amp per phase, but is capable of making and breaking currents up to 800 amp at 440 V. Two auxiliary poles are available for 5 amp at 440 V.

Exploded view of the Crabtree Type J-60 contactor unit. Right, the J-60 heavy duty contactor-starter

Review of Progress with Large Nuclear Power Stations in U.S.A.

By J. R. FINNIECOME, M.Eng., M.I.C.E., M.I.Mech.E., F.Inst.F., Consulting Engineer

6. General particulars of prototype large reactors for nuclear power stations in U.S.A.

The thermal rating of the reactor, the gross electrical capacity, the net electrical output, the total flow, the pressures and temperatures of the primary coolant, the steam conditions at the turbine stop valve and the net station thermal efficiency are briefly summarized for pressurized light water and boiling light water reactors in Table VIII. Similar detailed information for a graphite-moderated and sodium-cooled reactor and a fast breeder sodium-cooled reactor is presented in Table IX. These six nuclear power stations are located at:

(1) Shippingport (Pennsylvania)
(2) Rowe (Massachussetts)
(3) Indian Point (near New York)
(4) Dresden (near Chicago)
(5) Nebraska
(6) Lagoona Beach, Lake Erie.

Details of design data and certain significant features will be examined in the following sections.

7. Pressurized light water power reactors

The development of the pressurized light water reactor for nuclear power plant commenced in 1951 with the construction of the land based prototype for the U.S. submarine *Nautilus* at the National Reactor Research Station. The primary object was to test its feasibility, and on May 31, 1953, the reactor produced the predicted amount of power. The contract for the *Nautilus* was placed in 1952 and it was in commission in 1954. Up to April 30, 1958, it had steamed over 107,000 nautical miles of which 74,000 were while it was submerged. The U.S. Navy have undoubtedly been successful with the pressurized water reactor. A recent report reveals that the United States has 33 nuclear-powered submarines built, building or authorized by Congress. In addition there are four nuclear-powered surface ships under construction, three for the Navy and one for merchant service. The first is to be ready in 1960.

7.1. Shippingport nuclear power station

In 1954 it was decided to build a large scale nuclear power plant at Shippingport, Pennsylvania. As the operating experience on the previously cited prototype pressurized light water reactor proved satisfactory it was considered advisable to recommend this system for the station. The construction was started in July 1955, and the reactor reached criticality on December 2, 1957 and on December 23 it was tested at 60 MW(E). The essential particulars and the design data are summarized for reactor and the reactor vessel in Table X, for the primary pumps, valves and the heat exchangers in Table XI and the turbines in Table XII. The flow diagram is presented in Fig. 1.

7.2. Yankee nuclear power station

This plant consists of one reactor, four steam generators, one turbogenerator and their ancillaries.

1. Owners
   Construction and operation were organized by eleven of the major New England utilities and the project was incorporated as the Massachusetts Electric Company.
2. Location
   Rowe, on Deerfield River, near the Vermont-Massachusetts

Table VIII.—PROTOTYPE LARGE REACTORS FOR NUCLEAR POWER STATIONS IN U.S.A. (PRESSURIZED WATER AND BOILING WATER REACTORS)

	Company	Unit	Westinghouse and Duquesne Light Company	Yankee Atomic Electric Company	Consolidated Edison Company	Commonwealth Edison and others
1	Location		Shippingport Pennsylvania	Rowe Massachussetts	Indian Point near New York	Dresden near Chicago
2	Year of commissioning		1957	1960	1960	1960
3	Type of reactor		PWR	PWR	PWR	DPBR
4	Thermal rating of reactor	MW	232	392	585	624·2
5	Gross electrical capacity					
	(a) from the reactor	MW	100	145	163	192
	(b) from the superheater	MW	—	—	112	—
	(c) total	MW	100	145	275	192
6	Net electrical output					
	(a) from the reactor	MW	90	134	151	180
	(b) from the superheater	MW	—	—	104	—
	(c) total	MW	90	134	255	180
7	Primary coolant					
	(a) normal pressure	psig	2000	2000	1500	1000
	(b) design pressure	psig	2500	2500	1800	—
	(c) inlet temperature	°F	508	483	480	504·8
	(d) outlet temperature	°F	542	516	510	543
	(e) temperature rise	°F	34	33	30	38·2
	(f) total flow	gpm	60,000	—	128,000	—
8	Steam conditions at T.St.V.					
	(a) pressure	psig	605·3	450·3	355·3	950/450
	(b) temperature	°F	489·8	460	1000	—
9	Net station thermal efficiency	%	26·60	—	31·91	28·70

PWR Pressurized water reactor.
DPBR Dual pressure boiling water reactor.

border. (Site is 2000 acres).

3. Capital cost
   Total $50 Million
   Per kW of net station output $373
4. Contract
   Awarded June 1956. Work started on site in the autumn of 1957. Concrete poured in summer of 1958. Construction to be complete in autumn of 1960.
5. Type of reactor
   Pressurized light water moderated and cooled (PWR)
6. Ratings
   Reactor heat output (normal) 392 MW(H)
   Gross generator output (normal) 145 MW(E)
   Net station output (normal) 134 MW(E)
7. Fuel
   Enriched uranium oxide (UO_2)
   Initial enrichment (atoms %) 3·02%
   Final enrichment (atoms %) 2·29%

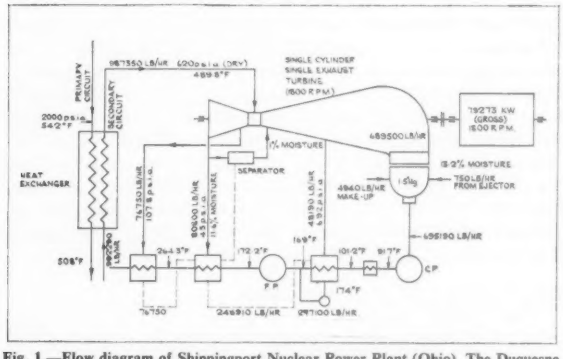


Fig. 1.—Flow diagram of Shippingport Nuclear Power Plant (Ohio). The Duquesne Light Company. Station service (a) for nuclear portion 6000kW (b) for turboalternator 3500kW
9500kW

Net output = 79273—9500 = 69773kW. Turbine heat rate = 11272 btu/kW. Turbine thermal efficiency = 30.2%. Net thermal efficiency = 26.6%

Table IX.—PROTOTYPE LARGE REACTORS FOR NUCLEAR POWER STATIONS IN U.S.A.
(a) Graphite moderated and sodium cooled reactor (SGR)
(b) Fast reactor and sodium cooled (FBR)

	Company	Unit	Consumers' Public Power District	Power Reactor Development Company (Detroit Edison)
1	Location		Nebraska	Enrico Fermi P.S. Lagoona Beach, Lake Erie
2	Year of commissioning	—	1959	1960
3	Type of reactor	—	SGR	FBR
4	Thermal rating of the reactor	MW	250	300/430
5	Gross generating capacity	MW	75	100/156
6	Primary coolant			
	(a) pressure	psig	300	100/200
	(b) inlet temperature	°F	—	552
	(c) outlet temperature (average)	°F	925	802
	(d) temperature rise	—	—	250
	(e) outlet temperature (max.)	°F	—	995
	(f) friction pressure loss	psi	—	42
	(g) total flow	lb/hr	—	$11·88 \times 10^6$
	(h) velocity	ft/sec	—	30·3
7	Maximum clad temperature	°F	—	1020
8	Maximum uranium temperature	°F	—	1300
9	Steam conditions at T.St.V.			
	(a) pressure	psig	785·3	585·3/885·3
	(b) temperature	°F	825	755/820
10	Final feed temperature	°F	—	400/430
11	Maximum rating of turbogenerator	MW	75	156
12	Steam quantity at T.St.V. (initial)	lb/hr	—	1,015,000
	(ultimate)	lb/hr	—	1,470,000
	Maximum fuel temperature (design)			4700° F
	Melting point of UO_2			5000° F
	Quantity of UO_2			50,000 lb
	Life of fuel			10,066 hr
	Burn-up of UO_2			8208 MWD/tonne
8.	Fuel pellets			
	Diameter			0·290 in.
	Height			0·60 in.
	Number per fuel rod			150
9.	Fuel rods			
	Seamless A.I.S.I. 304 stainless steel tubes. The ends of the tube are closed with stainless steel end plugs welded to the tubing to form a gas tight assembly to retain gaseous fission products released from the fuel material. The fuel rods extends the full length of the core.			
	Outside diameter of tube			0·337 in.
	Nominal thickness of tube			0·021 in.
	Length of each fuel rod			7·5 ft
	Lattice centre distance of fuel rods			0·425 in.
	Design pressure for tubes			2500 psi
	Cold hydrostatic test pressure for tubes (no deformation to take place)			3750 psi
	Number of fuel rods per each assembly (respectively)			305 and 306
	Total number of fuel assemblies			76
	Total number of fuel rods			23,218
10.	Fuel assembly			
	Total length (approx.)			110 in.
	Actual length (core)			90 in.
	Overall length			120·75 in.
	Cross sectional dimensions of each			$7·61 \times 7·61$ in.

Table X.—REACTOR AND REACTOR VESSEL OF THE SHIPPINGPORT NUCLEAR POWER PLANT (THE DUQUESNE LIGHT COMPANY)

	General		
1	Number of reactors	—	1
2	Number of heat exchangers	—	4
3	Number of turbo-generators	—	1
4	Number of loops per reactor	—	4
5	Minimum heat rate of reactor	btu/hr	790×10^6
6	Heat rate of each heat exchanger	btu/hr	263×10^6
7	Heat rate of three heat exchangers	btu/hr	789×10^6
8	Maximum rating of turbo-generator	kW	100,000
	Reactor		
9	Rating	kW	232,000
10	Normal design pressure for primary coolant	psig	2000
11	Maximum design pressure for primary coolant	psig	2500
12	Number of primary coolant loops per reactor	—	4
13	Total flow of pressurized water (four loops)	gpm	60,000
14	Inlet temperature of pressurized water	°F	508
15	Outlet temperature of pressurized water	°F	542
16	Temperature rise in pressurized water	°F	34
17	Total pressure drop of coolant through core, heat exchanger and pipe	psi	105
18	Mean diameter of core	ft	6
19	Length of core	ft	6
20	Fuel used	—	enriched uranium
21	Number of control rods	—	24
22	Material for control rods	—	hafnium
	Reactor vessel		
23	Overall height	ft	33
24	Internal diameter	ft	9
25	Nominal wall thickness	in.	8·5
26	Material for vessel	—	carbon steel
27	Total estimated dry weight of vessel	ton	250
28	Material for cladding	—	stainless steel
29	Thickness of hemispherical closure head	in.	10
30	Thickness of cladding	in.	0·25
31	Number of fuel port tubes	—	9
32	Thickness of glass wool insulation for entire vessel	in.	4

	Weight	1000 lb
	Minimum gap between fuel pellets and inside diameter of tube	0·0025 in.
11.	Core	
	Diameter (average)	75·1 in.
	Actual height between fuel elements	90 in.
	Life	10,066 hr
	Burn up of uranium	8208 MWD/tonne
	Material between fuel elements:	
	Fuel (UO_2)	50,000 lb
	Water	5610 lb
	Zirconium	2980 lb
	Stainless steel	12,900 lb
	Total	71,490 lb
12.	Control rods	
	Material	silver alloy—80% silver, 15% indium, 5% cadmium
	Number of control rods	24
	Number of control shims	8
	Shape	cruciform
13.	Primary coolant	
	Light water	
	Minimum pressure	1850 psi
	Normal pressure	2000 psi
	Maximum pressure	2150 psi
	Design pressure	2500 psi
	Pressure drop across the core	13·7 psi
	Pressure drop across the reactor	29·7 psi
	Number of coolant loops	4
	Total quantity of coolant in circulation	$37{\cdot}8 \times 10^6$ lb/hr
	Velocity of coolant along fuel rods	14·4 ft/sec
	Temperature of coolant in primary loops (average)	514° F
	Temperature of coolant in fuel bearing portion of the core (average)	516° F
	Coolant temperature rise in the core	33° F
	Coolant temperature rise in reactor vessel	30° F
	Temperature at the centre of fuel (max.)	4655° F
	Temperature at the surface of fuel (max.)	651° F
	Temperature at the outlet from hot channel	603° F
	Temperature of steam	475° F
	Pressure of steam	540 psia
	Pressure of coolant at inlet to reactor vessel	499 psia
14.	Reactor pressure vessel	
	Material	Carbon steel with stainless internal cladding
	Inside diameter	109 in.
	Thickness	8 in.
	Operating pressure	2000 psi
	Design pressure	2500 psi
15.	Containment vessel	
	Encloses all pressure parts of the main coolant system	
	Shape	spherical
	Diameter	125 ft
	Design pressure	34·5 psi
	Test pressure as % of design pressure	125%

Table XI.—PRIMARY PUMPS, VALVES AND HEAT-EXCHANGERS AT THE SHIPPINGPORT NUCLEAR POWER PLANT (THE DUQUESNE LIGHT COMPANY)

	Primary pump		
1	Total number of pumps for a reactor	—	4
2	Number of pumps for each loop	—	1
*3	Rating of motor for each pump (2300 volt 60 cycle)	kW	1200
4	Weight of each motor	ton	8·9
	Valves		
5	Number of main stop valves for each loop	—	2
†6	Nominal size of valve opening	in.	16
	Heat exchanger		
7	Rating of each heat exchanger	btu/hr	263×10^6
8	Number of heat exchangers for each reactor	—	4
9	Rating of three heat exchangers	btu/hr	789×10^6
10	Total rating of four heat exchangers	btu/hr	1052×10^6
11	Steam pressure at discharge at full load	psig	585
12	Steam pressure at discharge at no load	psig	870
13	Design pressure	psig	960
14	Primary coolant inlet temperature	°F	542
15	Primary coolant outlet temperature	°F	508
16	Drop in temperature of primary coolant	°F	34
17	Number of straight-tube type heat exchangers	—	2
18	Number of U-type heat exchangers	—	2
19	Diameter of straight-tube heat exchanger	in.	43
20	Height of straight-tube heat exchanger	ft	36
21	Overall length of U-type heat exchanger	ft	28
22	Diameter of U-type heat exchanger	in.	39

*Can be connected to two speeds
†With ports tapered to give 18 in. bore

7.3. Indian Point nuclear power station

The plant comprises one reactor, four steam generators one turbogenerator and their ancillaries.

1. Distinctive features
   (a) First privately owned nuclear power station in U.S.A.
   (b) First commercial reactor to use thorium.
   (c) First nuclear power station to introduce a separately oil-fired superheater.
   (d) No financial support from the government.
2. Owner
   The Consolidated Edison Company, New York
3. Location
   East Bank of the Hudson River

Table XII.—TURBINES AT THE SHIPPINGPORT NUCLEAR POWER PLANT (THE DUQUESNE LIGHT COMPANY)†

1	Gross output of turbo-generator	kW	60,000	79,273	100,000
2	Number of cylinders	—	—	one	—
3	Number of exhausts	—	—	one	—
4	Number of feed-heating stages	—	—	one	—
5	Quantity of steam through turbine stop valve	lb/hr	861,000	987,350	1,286,400
6	Pressure at turbine stop valve	psig	585	605	545
7	Temperature at turbine stop valve	°F	486·3	489·8	479·0
8	Vacuum (30 in. Hg bar)	in. Hg	28·5	28·5	28·5
9	Final feed temperature	°F	—	325	342
10	Moisture before separator	%	—	11·6	11·6
11	Moisture after separator	%	—	1·0	1·0
12	Moisture at turbine exhaust	%	—	12·7	13·2
13	Turbine heat rate	btu/kW	—	11,272	11,385
14	Turbine thermal efficiency	%	—	30·28	29·97
15	Net station thermal efficiency	%	—	26·6	—

(1) Cylinder barrel, between blades, lined with stainless steel.
(2) All blades to have Stellite face on leading edge wherever the moisture content of the steam exceeds 6% and tip speed of blades 900 ft/sec and above.

Materials used on plant

(a)	Static parts of the reactor plant such as heat exchanger vessels, heat exchanger tubes and pipes.	AISI type 304 (18-8 chrome nickel steel with very low carbon content).
(b)	Stressed parts such as springs.	Inconel or inconel-X
(c)	Rubbing parts such as those in control drive mechanisms.	Hardened stainless steel, chrome-plated stainless steel, various grades of Stellite.
(d)	Magnetic parts, such as magnetic slugs, control rod position indicators.	Martensitic stainless steels.

at Indian Point in the Westchester County, about 24 miles from New York City.

4. Capital cost

Total	$90 million
Total per kW of gross electrical output (275 MW)	$327
Total per kW of net electrical output (255 MW)	$353

5. Progress on site

On March 25, 1955, the company filed a licence application with the Atomic Energy Commission (AEC). Work commenced on site in the summer of 1956. In operation in 1960.

6. Type of reactor

Pressurized light water moderated and cooled (PWR)

7. Ratings

Heat output of reactor	585 MW(H)
Gross electrical capacity from reactor	163 MW
from superheater	112 MW
total	275 MW(E)
Net electrical station output from reactor	151 MW
from superheater	104 MW
total	255 MW(E)
Net station heat rate	10,700 Btu/kW hr
Net thermal efficiency of station	31.91%

8. Fuel

Homogeneous mixtures of uranium oxide (UO_2) and thorium oxide (THO_2), thus providing for U233 to extend the fission life of the fuel.

Weight of uranium oxide (UO_2) 275kg	606 lb
Weight of thorium oxide (THO_2) 8275kg	18,240 lb
Total weight of mixture 8550kg	18,846 lb
Ratio of weight of thorium oxide to uranium oxide	30·06

The two materials are homogeneously mixed and formed into pellets, incorporated as rod type fuel elements clad with stainless steel.

9. Fuel rods

These are loaded with the pellets. The ends of the rods are sealed by welding an end cap on each tube. The actual fuel region is prevented from coming into contact with end cap by the use of an insulating pellet.

Outside diameter of fuel rods	0·3125 in.
Thickness of tubes	0·020 in.
Pitch of square lattice	0·3805 in.

10. Fuel elements

Number of fuel elements	120
Number of rods for each fuel element	206
Total number of rods	24,720
Overall length	135$\frac{3}{8}$ in.
Net active fuel length	95·25 in.

The fuel elements are arranged in a square lattice and contained in Zircaloy-2 sheet of 0·180 in. thickness, formed to the same contour as the fuel bundles.

11. Core

Diameter (mean)	6·5 ft
Active height	8·0 ft
Life without reloading	660 days

The core has 120 box-type fuel elements each 5·775 in. square.

12. Control rods

Material	hafnium
Number of shim control rods (These are arranged roughly in two concentric circles in the core)	21
Width of shim	7·5 in.
Thickness of shim	$\frac{5}{16}$ in.

13. Reactor

Diameter	6 ft
Height	6 ft

14. Coolant (primary)

Light water

Pressure	1500 psig
Total flow	$53{\cdot}9 \times 10^6$ lb/hr
Total flow	128,000 gpm
Mean inlet temperature	480° F
Mean outlet temperature	510° F
Mean temperature rise	30° F

15. Reactor pressure vessel

Material	carbon steel, SA-212, Grade B

The vessel is clad on the inner face with 0·109 in. type-304 stainless steel.

Diameter (inside)	9·75 ft
Overall height (approximate)	40 ft
Operating pressure	1500 psig
Design pressure	1800 psig
Number of inlet connections at bottom	4
Number of outlet connections at top	4
Minimum inside diameter of inlet and outlet connections	20$\frac{1}{8}$ in.
Number of openings for control rod nozzles (in bottom hemispherical head)	21

16. Containment vessel

This eliminates the possibility of dispersing radio-active vapour over the area surrounding the station.

Design pressure (internal)	27·5 psi
Shape of the vessel	sphere
Diameter of the vessel	160 ft
Thickness	$\frac{7}{8}$ in.
Material	carbon steel

The vessel contains the nuclear reactor and all the high pressure, high temperature coolant auxiliary equipment, also a 75-ton gantry crane for handling equipment.

17. External radiation shield

Consists of a concrete wall and

roof surrounding the containment vessel. Constructed of ordinary concrete about 6 ft thick up to 65 ft above ground level. The complete self-supporting trussed roof is about 3 ft thick.

18. Externally oil-fired superheater

Pressure at inlet to superheater	420 psia
Temperature at inlet to superheater	449° F
Temperature at outlet from superheater	1000° F

19. Turbogenerator

Manufacturer	Westinghouse Electric Co.
Steam cycle	regenerative and superheated
Gross electrical rating (maximum)	275 MW(E)
Net electrical station output (maximum)	255 MW(E)
Speed	1800 rpm
Total steam at turbine stop valve	2,200,000 lb/hr
Steam pressure at turbine stop valve	370 psia
Steam temperature at turbine stop valve	1000° F
Vacuum at turbine exhaust at 30 in. Hg bar.	28·5 in. Hg
Wetness at turbine exhaust	5·9%
Final feed temperature	332° F
Number of feed heating stages (three heaters and one deaerator)	4
Number of flows at the turbine exhaust	2
Maximum length of the blades of the last rows	44 in.

20. Condenser

Manufacturer	Ingersoll-Rand
Type	two shell single pass
Total cooling surface	212,000 sq ft

All tubes are welded to the tube plates, instead of the conventional rolling.

The heat balance diagram for this station is given in Fig. 2.

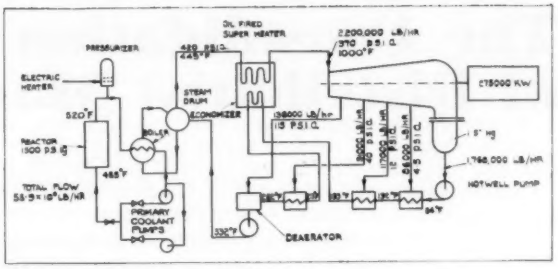


Fig. 2.—Heat balance diagram of the Indian Point Nuclear Power Station of Consolidated Edison Company

Trackside Measurement of Electrified Rails

A new clip-on ammeter for measuring current in railway electrification systems is claimed by Ferranti Limited, Hollinwood, Manchester, to be the first of its type to have been developed specifically for railway applications. It is basically similar to the conventional Ferranti clip-on ammeter operating on the split-core current transformer principle, except for the triangular-shaped core which is necessary so that all standard types of railway lines can be easily embraced and measurements taken quickly and efficiently by linesmen.

Six separate ranges, 0–10, 25, 50, 100, 250 and 500 amp a.c., are obtainable on the instrument, which are controlled by a thumb-operated selector switch and accuracy is within 5% of full scale on all ranges.

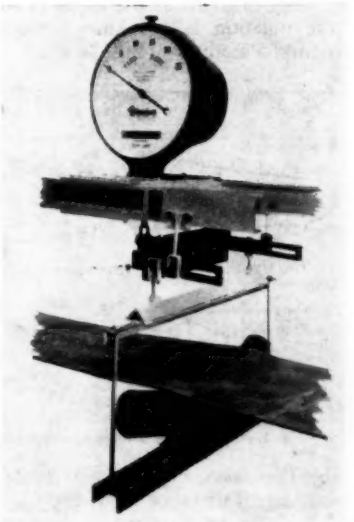
Ferranti clip-on ammeter which has been developed specifically for railway application

Feed Rate Indicator for Belt Conveyors

A weigh beam type conveyor feed indicator linked to a suspended belt idler has been calibrated to show the feed rate in ton or lb per hour for a given belt speed.

The unit can be fitted to either flat or troughed conveyors but in view of the wide range of belt widths and speeds in use, each feed rate indicator is specifically designed and calibrated for a particular conveyor.

The mild steel weigh beam is fitted with self-aligning knife edges and supports and is coupled to the dust tight dial head. The makers, Richardson Scale Company Limited, Albert Street, Bulwell, Nottingham, supply the channel support frame for the dial head as shown in the illustration.



The Richardson weigh beam type indicator for belt conveyors

The Consolidation of Distributed Masses

By considering the effect of substituting concentrated masses at two or more distributed points the solution of static and dynamic balancing problems may be appreciably shortened. Dealing first with centres of gravity and moments and products of inertia the principle of substitute masses is extended to problems in deflexions and vibrations.

By W. H. SHEPPARD, B.Sc.(Eng.)

A DISTRIBUTED mass may be regarded as concentrated at its centre of mass, which to all practical purposes is at its centre of gravity, but this only applies to static considerations as when used to determine the centre of gravity of a larger member in which the original is to be included. If rotary inertia effects are to be considered however, the mass must be considered as concentrated at two or more distributed points to give the same effect. For the investigation of these substitute masses laminae and solids are regarded as concentrated into point masses but the same principles apply to areas, and volumes and in this respect centre of gravity is taken to imply centre of area, volume or mass as appropriate.

1. Static equivalence

In this case the centre of gravity of the substitute mass or masses is coincident with that of the original.

(a) *One mass.* This is the simplest case and effected by regarding mass M at the C_g as is common practice and if the position is not known must be determined by recognized methods. (Fig. 1a.)

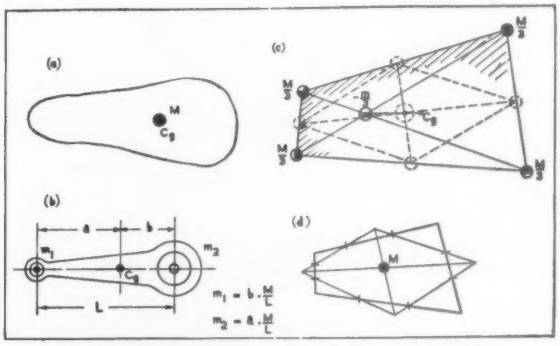


Fig. 1.—Treatment of one mass by method of static equivalence

(b) *Two masses.* Equal masses M/2 may be disposed at any equal distance from the C_g. Unequal masses m_1 and m_2 may be disposed at distance a and b such that $m_1a = m_2b$, thence $m_1 = b.M/L$ and $m_2 = a.M/L$, a typical example being the connecting rod as shown in Fig. 1b. Conversely, if the member is weighed at each end, the position of the C_g may be calculated

$$a = W_2/W \quad b = W_1/W$$

W = Total weight and W_1 and W_2 the weights as measured at the ends.

(c) *Three or more masses.* Equal masses may be disposed at equal distances apart round the circumference of a circle with centre at the C_g. Unequal or equal masses may be disposed in any manner which gives the same C_g,

i.e. $\bar{x} = \Sigma mx/M \quad \bar{y} = \Sigma my/M$

Equal masses may also be disposed at the corners or centres of edges or faces of the regular solids, viz. cube, tetrahedron, octahedron, dodecahedron, isocahedron.

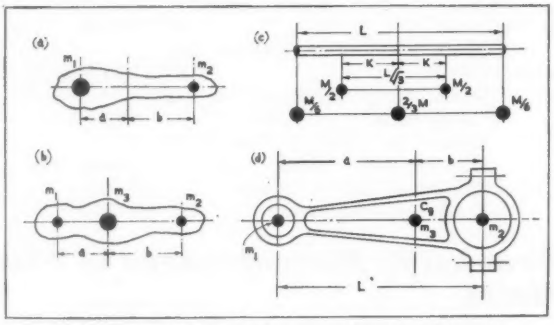


Fig. 2.—Treatment of two and three masses by method of dynamics

(d) *Quadrilateral.* In this case the figure may be regarded as equal masses M/3 at each corner and an equal negative particle −M/3 at the intersection of the diagonals as shown in Fig. 1c. The corner masses may alternatively be regarded at the centres of the edges and thence as 4M/3 at the centre of the parallelogram thereby formed. To find the C_g the straight line joining this point to the intersection of the diagonals of the quadrilateral may be extended by $\frac{1}{3}$ of its length giving the required point.

Alternatively the C_g may be obtained by trisecting each edge of the rectangle, drawing a parallelogram through the points of trisection as shown in Fig. 1d, the C_g being at the intersection of its diagonals.

2. Dynamic equivalence

In general, dynamic equivalence is required together with static equivalence to give the same total mass M with the same C_g and also the same moment of inertia about any point. The latter will be considered first however about the C_g.

Let $m_1, m_2, m_3 \ldots$ be the individual masses.

Let $x_1, x_2, x_3 \ldots y_1, y_2, y_3 \ldots$ be their respective distances from the axes.

For the same total mass $\Sigma m = 0$

For the same C_g $\Sigma mx = 0$ and $\Sigma my = 0$

For the same moment of inertia $\Sigma mk_x^2 = MK_x^2$ and $\Sigma mk_y^2 = MK_y^2$

In-line masses

(a) *two masses*. These must be disposed on a straight line through the C_g. By substituting in the formulae it may be shown $K^2 = ab$. (Fig. 2a.). The simplest case is to take $m_1 = m_2 = M/2$ whence $a = b = K$.

(b) *three masses*. Referring to Fig. 2b it will be realized that the distances may be chosen to suit the masses or vice versa. Again by substituting in the formulae it may be shown,

$$m_1 = MK^2/a(a+b) \qquad m_2 = MK^2/b(a+b)$$

or alternatively

$$a^2 = m_2MK^2/m_1(m_1+m_2) \quad b^2 = m_1MK^2/m_2(m_1+m_2)$$

If $a = b$, $m_1 = m_2$ and $2a^2m = MK^2$.
In all cases, $MK^2 = I$, the moment of inertia.

Straight rod

In this case the two concentrated masses M/2 will be disposed at distance $L/2\sqrt{3}$ from the centre or $L/\sqrt{3}$ apart. Alternatively, a mass M/6 may be considered at each end and 2M/3 at the centre.

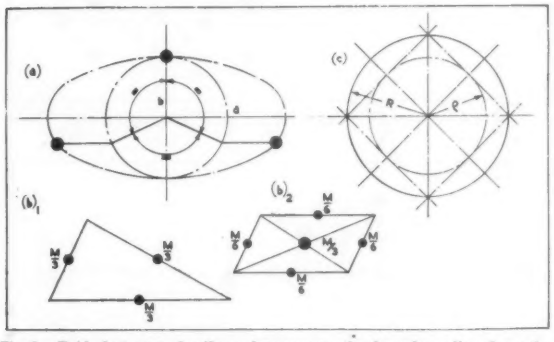


Fig. 3.—Equivalent mass of uniform plate: construction for polar radius of gyration

Connecting rod

This is a very important case and it is often stated that a connecting rod cannot be represented dynamically by concentrated masses unless extended beyond its ends. This is true of two masses, but three masses give a relatively simple solution as shown in Fig. 2d. In this case let L = length between centres and a and b the distances to the C_g. Then the connecting rod may be considered in full dynamic equivalence (including *product* of *inertia* as will be explained later) by I/aL at the small end, I/bL at the big end and the remainder at the C_g, I being the moment of inertia about an axis through the C_g.

Note: It should be clearly understood that in-line substitutions only apply to slender items or where, as in the case of a connecting rod, only the effect of rotation about a lateral axis is being considered. With further regard to the connecting rod, it will be appreciated that the mass could be regarded as concentrated at the centre of oscillation, but this would only apply to oscillation about the small end whereas three-point substitution gives complete equivalence in the relevant plane.

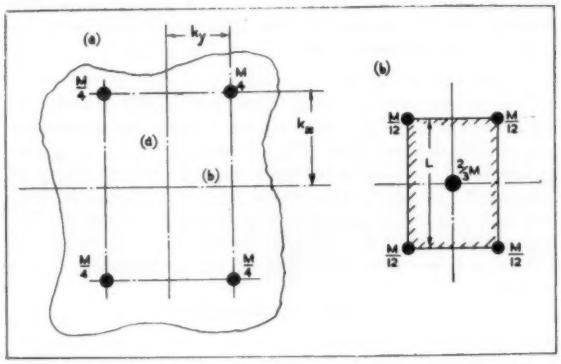
Plane distributed masses

In this section the effect of using concentrated masses for substitution will be considered. It may be shown mathematically that a uniform plate may be considered concentrated evenly round the circumference of a circle of radius equal to the polar radius of gyration (ρ) which for a circle is equal to $\rho/\sqrt{2}$ (linear radius of gyration for a circle $= \rho/\sqrt{2} = R/2$.) Fig 3c shows a neat construction for this radius. It may further be shown that this circle may be regarded as any number of equal concentrated masses equally disposed around this circle. This also applies to any regular figure which has more than two lines of symmetry and in the case of an equilateral triangle the masses are conveniently arranged. on the edges as shown in Fig. $3b_1$. Polygons may be built up from triangles. (Fig. $3b_2$.) In other cases the masses may be regarded on an ellipse expanded from a circle in the ratio

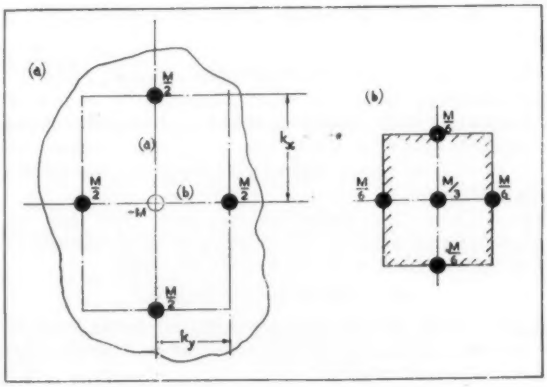
$$a/b = (kx/ky)^2$$

a and b being the semi-axes. (Fig. 3a.)

If the masses are not considered at the polar radius of gyration it will be necessary to introduce a positive or negative mass at the C_g to give the correct total mass. (If only the moment of inertia or product of inertia *about this point* is being considered, this mass may be ignored).



Figs. 4 and 5 (top and bottom).—Rectangular arrangements of separate masses and uniform plate



Three masses are the least number required in a plane configuration but four give greater symmetry and ease of application.

Fig. 4 shows rectangular arrangements. The simplest case is as shown with the masses equally distributed at the corners of the rectangle formed by the radii of gyration. This has the advantage that no central mass is required. In the case of a rectangular plate, k^2_x is equal to $L^2/12$ and similarly for k_y. However, if in this case the masses are disposed at the corners, a central mass must

be introduced with values as shown in Fig. 4b. Conversely, if it is desired to make a rectangular plate to equivalent k values, $L = 2\sqrt{3}\,k_x$ and similarly for k_y for the same thickness and density. Fig. 5 shows "spider" arrangements. These have the advantage that the masses are on the principal axes but on the other hand a compensating mass is usually necessary at the C_g to give the correct total mass. It may be shown mathematically that in any case $a/b = (k_2/k_y)^2$ and this also applies to rectangular arrangements. With the arrangements shown the substitute masses are as indicated but if $a = \sqrt{2}k_x$ and $b = \sqrt{2}k_y$ there is no central mass. If the masses are considered at the corners of a rectangular plate as shown in Fig. 4b the values are as indicated. Unequal masses may be used giving a variety of arrangements. In particular

$$m_1 = M/2(k_x/\rho)^2 \text{ and } m_2 = M/2(k_y/\rho)^2$$

In this case there is no central mass and $a = b = \sqrt{a^2+b^2}$ the polar radius of gyration (ρ).

With regard to a rectangular plate if $a = \sqrt{2}k_x$ and similarly for b, masses at this distance would have no central compensating mass.

Solid distributed masses

This section will be considered in a similar manner to the previous but for convenience simple arrangements will be considered first. Fig. 6 shows the rectangular arrangement. In this case equal masses are arranged at distance k from each axis and it will be appreciated that here again there is no central compensating mass. The dispositions are more difficult to calculate however. If a, b, and c are the half sides of the rectangular prism formed,

$$a^2 = \tfrac{1}{2}[k_y^2+k_z^2-k_x^2]$$

and similarly for b and c.

If the masses are not at the radius of gyration

$$m = M/8[k_x/\alpha,\ k_y/\beta,\ k_z/\gamma]^2$$

α, β, γ being the respective distances.

In the case of a rectangular prism of dimensions A, B and C.

$k_x^2 = \frac{1}{12}(B^2+C^2)$ and thence $a^2 = \frac{1}{24}[2A^2+B^2+C^2]$

and similarly.

Conversely if it is desired to make a rectangular prism of equal k values

$$A^2 = 6(k_y^2+k_z^2-k_x^2)$$

and similarly.

Fig. 7 shows the spider arrangement. This has the advantage that k values are considered in the directions of the principal axes. If the masses are equal

$$a^2 = M/4m(k_y^2+k_z^2-k_x^2)$$

Regular solids may be considered but are rarely required in practice. (The cube may be regarded as a special case of a rectangular prism.)

(1) *Cube* may be regarded as
- (a) 6 equal masses M/6 at centre of each face.
- (b) 8 equal masses, M/24 at each corner and 1 mass 2M/3 at centre.
- (c) 12 equal masses, M/24 at centre of each edge and 1 mass M/2 at centre.

(2) *Regular tetrahedron* may be regarded as
- (a) 4 equal masses, M/20 at each corner and 1 mass 4M/5 at centre.
- (b) 4 equal masses, 16M/45 at each corner and 1 negative mass −19M/45 at centre.
- (c) 6 equal masses M/5 at centre of each edge and 1 negative mass −M/5 at centre.
- (d) 4 equal masses M/4 in direction of corners at radius $r = a/\sqrt{15}$

Note particularly that these substitutions apply to the actual solids. For irregular solids the masses may be regarded as disposed on a sphere expanded to an ellipsoid. Other combinations combining "rectangular" and "spider" arrangements may be evolved for both plane and solid configurations.

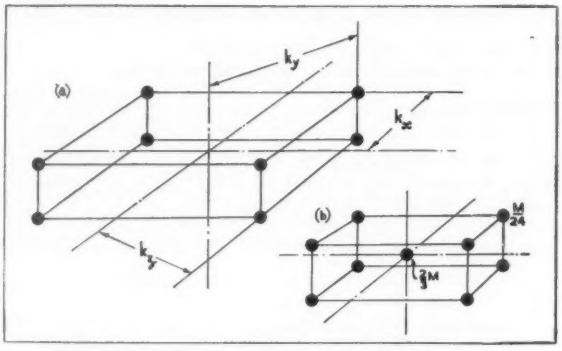


Fig. 6.—Rectangular arrangement of "solid" distributed masses

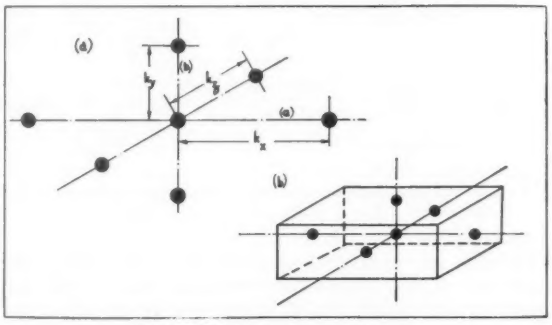


Fig. 7.—"Spider" arrangement of masses

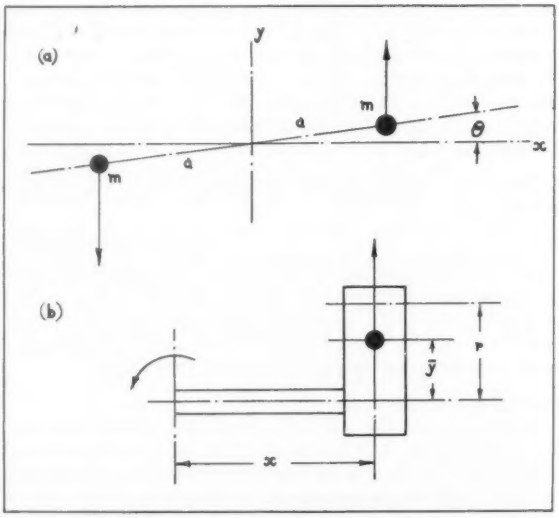


Fig. 8.—Product of inertia: two mass systems

3. Products of inertia

Considering any plane area, the product of inertia is given by

$$P = (I_x - I_y)\sin\theta\cos\theta = \tfrac{1}{2}(I_x - I_y)\sin 2\theta$$

from which it follows that any configuration with the same or same difference in moments of inertia has the same product of inertia. In particular, the equivalent systems previously determined will have the same product of inertia for any angular displacement. It may also be deduced that this applies to solid configurations.

If only product of inertia is being considered however, a simple two-mass system may be considered as in Fig. 8.

Then $m = M/2$ and $a = \sqrt{k_y^2 - k_x^2}$

This is of importance in balancing of engines, correcting "wobble" in rotors and similar problems.

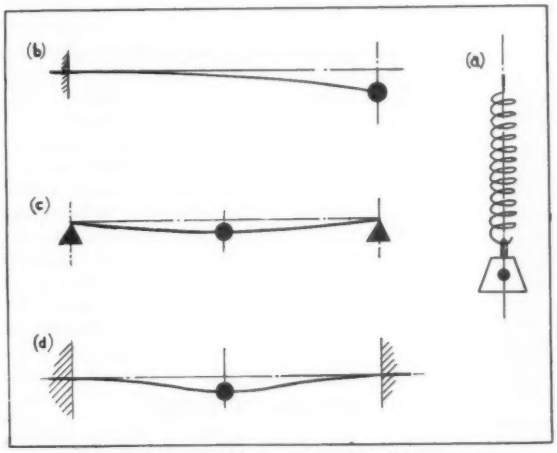


Fig. 9.—Deflexion: equivalent mass in spring and beam systems

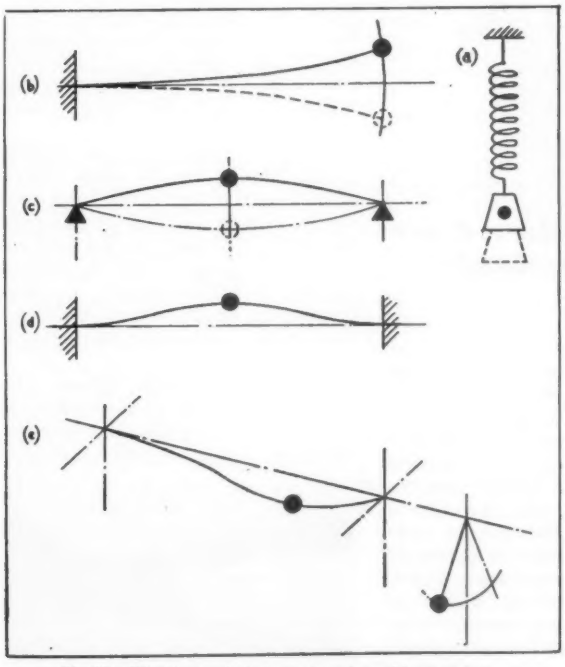


Fig. 10.—Vibration: equivalent mass in spring and beam systems

These problems are usually associated with centrifugal force and in this case it should be understood that for these purposes the mass is regarded as concentrated at its centre of gravity. For example in the crank in Fig. 8b the mass is considered concentrated at radius $\bar{y}$ and the effect at the crank pin is

$$W.\bar{y}/r$$

General note: In the foregoing section effects have been considered with reference to the centre of gravity. It may be shown however by the theorem of parallel axes and transfer theorem respectively that these principles apply to transferred axes but the compensating mass at the C_g *must* be retained.

4. Deflexions

Considering first the simple deflexion of an elastic fibre or a spring as shown in Fig. 9a, it may be shown that for deflexion purposes the effect of the weight of the fibre or spring when hanging in a vertical position may be regarded as 1/2 its weight acting at the end.

Then deflexion $\delta = W^1/\lambda$ or W^1/S

l = length

= modulus

$$S = \text{stiffness} = \frac{\lambda/l}{l}$$

$W^1 = W + \tfrac{1}{2}w$

Beams are usually treated separately as regards concentrated or distributed loads but may easily be regarded as compound beams by using an equivalent concentrated mass for the distributed portion.

$$\text{Let deflexion of beam} = \frac{WL^3}{QEI}$$

Let q be the proportion of beam to be regarded as concentrated.

Then for a

Cantilever	$Q = 3$	$q = \frac{3}{8}$,
Freely supported beam ...	$Q = 48$	$q = \frac{5}{8}$,
Encastre beam	$Q = 192$	$q = \frac{1}{2}$

5. Vibrations

Considering an elastic fibre or spring vibrating under the action of a terminal mass as shown in Fig. 10a, it may be shown that for vibration purposes the effect of the fibre or the coils of the spring may be regarded as $\frac{1}{3}$ of its mass acting at the end.

Whence $T = 2\pi\sqrt{L/g}$ or $2\pi/\sqrt{\mu}$

where L = length of equivalent simple pendulum

= static deflexion δ

μ = vibration modulus

$= m^1/S$ or W^1/gS

With regard to a simple pendulum, the correction for the weight of the rod is given by $L^1 = L + w/6W$

W = weight of bob

w = weight of rod

Whence $T = 2\pi\sqrt{L^1/g}$

This correction applies also to a filar suspension but in this case

$$T = 2\pi k/r\sqrt{L/g}$$

k = radius of gyration

r = radius of wires

Vibrating beams

These are more difficult to consider as concentrated beams as the effect varies according as to whether the

mass is mainly distributed or concentrated. It is shown in books on mechanics that close approximations may be obtained by assuming functions for the shape of the vibrating beam, but by blandly assuming a cubic function for a cantilever a result for the frequency 40% in error may be obtained, ignoring the fact that a cubic function alone is impossible. A thorough investigation was carried out and it was found that by assuming static deflexion as for a concentrated or distributed load, close approximations could be obtained. The same applies to sinusoidal functions, but other functions, especially simple power functions should be treated with caution. The following table gives a summary of the results obtained.

Proportion of mass of beam to regard as concentrated

Cantilever varies from 0·257 fully distributed to 0·236 fully concentrated. Approximately $\frac{1}{4}$.

Freely Supported Beam varies from 0·504 fully distributed to 0·486 fully concentrated. Approximately $\frac{1}{2}$.

Encastre Beam varies from 0·406 fully distributed to 0·371 fully concentrated. Approximately $\frac{3}{8}$.

In the case of an irregular beam it is most satisfactory to consider static deflexion and it may be shown that the frequency of vibration is the same as that regarding the beam swinging sideways under static deflexion. (Fig. 10e.)

Then $L = \Sigma mx/\Sigma m$ and $T = 2\pi\sqrt{L/g}$

Conclusion

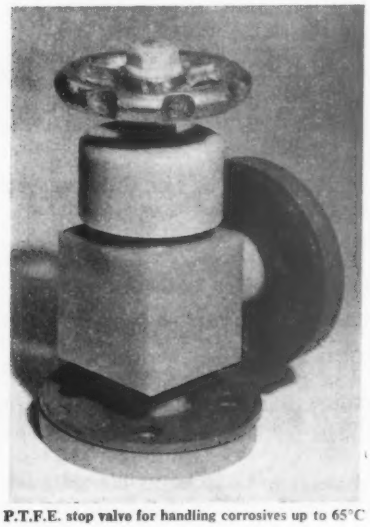
It is hoped that the principles expounded in the foregoing article of treating distributed masses as concentrated will not only simplify these calculations but also give more accurate results when the effect of attached masses would otherwise be ignored.

Flanged P.T.F.E. Stop Valve

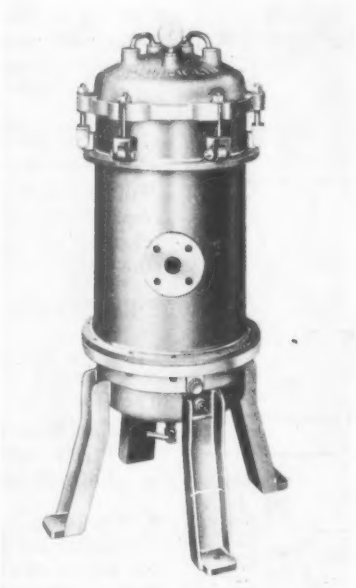
A fine-adjustment valve with a P.T.F.E. seat, and suitable for all corrosive liquids up to 65° C, has been introduced by the Chemical Pipe & Vessel Company Limited, Godstone Road, Kenley, Surrey.

Apart from its uses in the chemical and allied industries, this valve can be used on board ships, in connection with the conversion of sea water.

This valve is an addition to the range of corrosion-resisting valves, up to 2 in. bore, and is available with flanged ends and, to a smaller extent, in socket ends for welding into low-pressure lines. The range also includes pressure-relief valves and non-return valves made from H.D. polythene, rigid P.V.C. and P.T.F.E. The sizes of the new valve are $\frac{1}{2}$ in. and $1\frac{1}{2}$ in., and the prices £9 and £17 respectively.



P.T.F.E. stop valve for handling corrosives up to 65°C



Using interchangeable cartridge elements the Menrow multi-purpose treatment unit provides versatile filtration for either straight or detergent oils

Fuel Oil Filter Unit with Discardable Elements

A simple filtration unit with a wide application and produced in sizes up to flow rates of 1,400 gph has been designed by Menrow Limited, 1, Sekforde Street, London, EC1 for filtering jet engine fuel, bypass filtration of diesel engine lubricating oil and for the purification of marine diesel fuel oil. The unit is claimed equally efficient for conditioning either straight or detergent oils and will adjust acidity and remove acids, gums, tars, resin and asphaltenes. The filter elements used in the Menrow multi-purpose treatment unit can be filter baskets or candles, micro-screen gauze elements, wire wound strainer elements or throw-away filter cartridges. The throw-away cartridge consists of a fibre cellulose cylinder produced in a laminated form with layers of three different porosities so that coarse dispersants are trapped on the outer layer and finely micronized dispersants are filtered out by the inner layers. The cartridge is bonded by an epoxy type resin to ensure rigidity for ease of extraction and replacement.

Surform Draw Plane

The latest addition to the Surform range is a draw plane incorporating the non-clogging Surform blade. The heavy alloy body of the draw plane has a convex base which determines the cutting angle of the blade teeth and results in a very fast cutting tool which is ideal for large stock removal.

Using a pulling action the control of the tool is by the main handle and the curved tip at the front with the main force exerted by the right (or rearmost) hand. On flat surfaces a rocking motion should be used to ensure that the impact of any obstruction in the surface, such as a knot or nail, is taken evenly throughout the blade.

The Surform draw plane No. S 120 made by the Surform Division of Simmonds Aerocessories Limited, Treforest, Glam., retails for 15/6.

Surform draw plane for fast stock removal

Further Aids to Presswork

- ***Miniature toggle press***
- ***Piercing small holes***
- ***Retaining scrap in the top tool***
- ***Adjustable ejector for top tool***

By J. A. WALLER

There are many occasions in the light engineering workshop—in the radio industry for example—where the orthodox style of press using a comparatively large press tool creates a rather cumbersome assembly, and in the case of the latter the tooling costs are often well out of proportion to the importance and size of the article being pressed. A small press is the solution to this problem; one of the bench variety where an operator can sit down and rapidly insert the strip or parts without fatigue or waste of time, but there are still those occasions where the very baby of machines is deemed necessary and such an example is well within the scope of the average shop despite the fact they may not produce their own tools for the usual run of work.

To illustrate where a press of this type is useful, the opportunity is taken to portray in Fig. 1 an assembly of details made up from thin material with a thin walled plastic flanged shaped bush—an assembly that while needed in some thousands, required a certain degree of dexterity in handling on the machine, and this meant that a clear close-up view was essential in order to ensure that the operator could arrange them correctly and quickly without having to lean too far over the die and machine. The few dimensions included on the drawing reveal the approximate size of this article, but the essential feature was to secure a tightly fitting bush A in conjunction with the two other details B and C.

"Watchmaking" parts demand minute clearances if they are to function satisfactorily, thus the clearances given to each part is of some considerable importance in this build-up, and fits almost approaching a tight press fit are really essential if all discernable movement is to cease between the pieces. Some accurate tooling is thus necessary prior to insertion in this closing tool and if the parts are given a decided bump on the turn over of the upper flange on the bush A this gives the required degree of tightness and prevents rotation of the bush, the plastic ring or the outer drawn shell.

The toggle press does not exhibit any unusual ideas except perhaps for the stroke setting device, and the assembly is made on a base of mild steel; on the original version this was a a scrap component with two holes bored for the vertical locating pillars. Whether bushes B (Fig. 2) are necessary in this base member is entirely a matter of base thickness; as the base is merely clamped direct to the workbench extra thickness is really an asset, but if the only plate available is thin, then the possibility of obtaining perfectly vertical pillars is remote and difficulty is usually experienced in assembling the top plate F because of the inclination of the pillars and springing them into place is not always successful. The inclusion of bushes, then, is a wise precaution as the

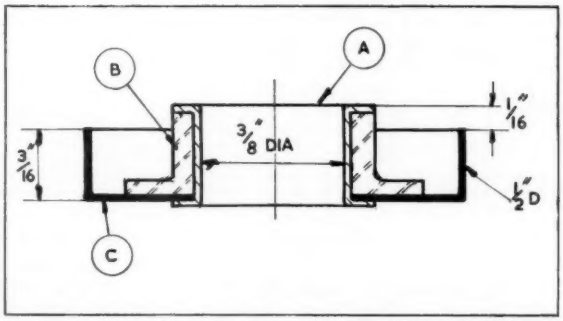


Fig. 1.—Small assemblies of this type are easily and successfully produced on this class of small press; the clear view afforded the operator makes location and handling on and off the lower tool a simple matter. A, aluminium bush; B, plastic flanged ring; C, aluminium drawn shell

heads can compensate for the lack of material thickness in the plate.

In addition to providing extra length for the ram M, the adjuster N when screwed further into the top plate decreases the distance between the pivot screw L and the baseplate and so gives adjustment to the tools if this is necessary. A locknut R prevents any slacking back of the adjuster during the working of the press.

The ram, seen at Fig. 3 in section, is a headed part with a long shank, the idea being that when the adjuster is moved the ram does not turn but merely descends as the adjuster is lowered. To prevent it falling out should it become necessary to dismantle the press, a collar P is secured to the end and cross pinned. The ram can remain stationary during the action of the links yet move up and down when the adjuster is moved.

In the toggle action the links straighten out and exert the pressure in a vertical direction and so cause the sliding plate D carrying the punch to move. Two flat links H straddle the sliding plate and are held to it by tightly fitting shouldered screws L, and as frequent use of the press will result in eventual wear, hardening is considered necessary for these. If the plates are also treated in this manner—locally round the holes is sufficient—and the pivot pin K made a good fit and hardened, then the parts will give long service.

The U-link G is not readily made from a solid piece of material and a much more efficient way is to weld the arms to the block accommodating the handle. Welding the latter is also feasible though there is no difficulty in tapping a hole in the block and fitting the handle into this.

Whether hardening of the pillars is necessary is a matter for consideration during the initial stages. The bushes that slide up and down them would be treated as a matter of course, and as the shafts are fairly short the

boxes required for the case hardening process are likely to be available and hardening and grinding is thus well worth while.

The pillars are spaced about 4 in. apart and 8 in. between the top and bottom plates makes a useful size of machine capable of undertaking numerous jobs. A point which needs emphasis is the smooth operation of the sliding pieces; the slide D and the toggle links G and H should move freely as much of the success and popularity of this equipment depend on this.

A previous remark that perfectly vertical pillars are essential is repeated, as a variation of as little as a thousandth of an inch between the top and lower positions

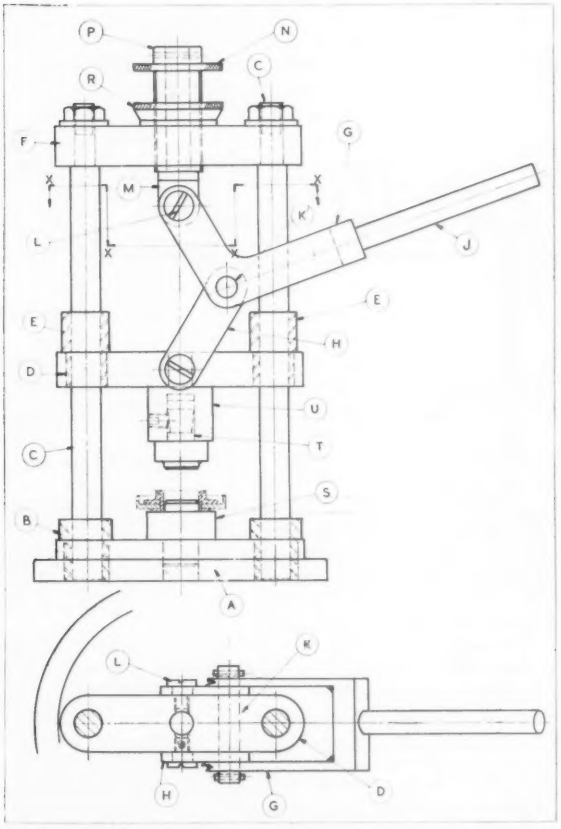


Fig. 2.—Simplicity is the keynote of the design in this toggle press, but accuracy in producing the various details ensures they work easily, almost at the touch of a finger

can create tightness and make the press virtually impossible to operate if the bushes sliding on them are a good fit. Boring all three plates in unison is the ideal method in such circumstances, and time spent on this part of the construction is compensated by freedom of movement during the operating stages.

Similar action is desirable when dealing with the links, but here drilling and reaming the pieces together is sufficient, but the holes must fit the pins without any suggestion of binding as a single pin left like this can cause an operator to exert a much heavier pressure than should be necessary. The provision of oil holes is useful though oil applied round the edges is sufficient.

If these hints are followed the expression finger tip control is easily justified and the press enters the precision class that makes it a pleasure to operate.

The tools used on this class of equipment are invariably simple in design as piercing, blanking, drawing and deep forming are more efficiently undertaken on the normal press using strip feeding or other mechanical devices to give a fast production rate. In the case under consideration the pieces are assembled in their correct order; in practice the operator found it more convenient to put together a tray load; from there they were picked up and placed on the locating pin and a quick movement lowered the ram and caused the upper punch T to clench over the protruding bush to form the assembly. Fig. 2 indicates the simplicity of these tools.

On the lower bolster the die or similar item is located in a hole or recess as shown, and prevented from moving if desired by three or four socket head screws with at least two tapped holes in the die to use as jacking screw holes in order to lift it from the base without having to unclamp the base from the bench.

As many of the punches for the upper member are similar in size, a holder attached by three screws will give an extension as shown and permit securing the punch with a single grub screw; a procedure which makes tool changing a matter of moments.

While emphasis is on the lighter bending, embossing

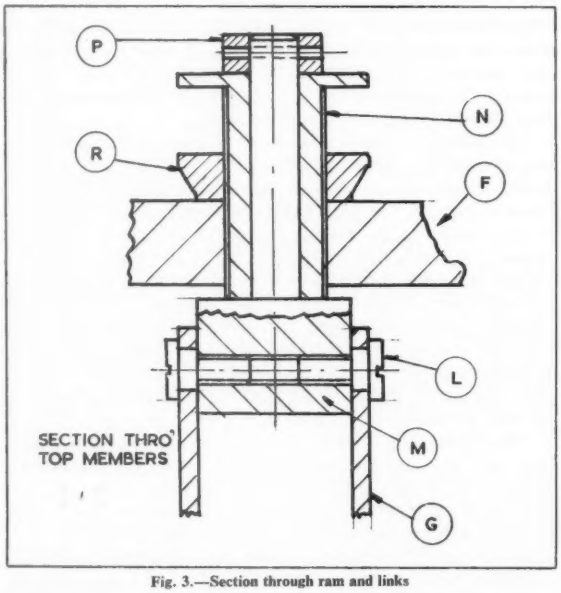


Fig. 3.—Section through ram and links

and other forming processes associated with press work, this tiny press is well suited to punching small holes in thin strip; the $\frac{1}{16}$ in. variety through $\frac{1}{32}$ in. material is typical of many jobs, and as numerous components of this nature are drilled in a jig where the loading time is often well out of proportion to the cutting operation; so here is a case for the press.

Embossing has been mentioned, and a special holder for steel stamps is useful for numbering or lettering parts made of soft material. Rather too heavy a blow is required for steel, but aluminium or even brass is marked without difficulty.

Dimpling is a form of embossing; the tools for such an operation are probably the simplest devised for production purposes as they consist of a centre punch style of upper tool and a countersink in a piece of steel for the die, but only for very shallow details is the press

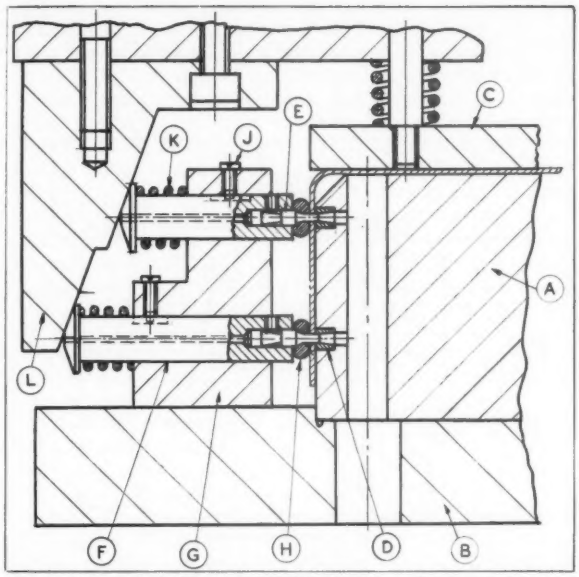


Fig. 4.—Side piercing holes with tools of this design is an efficient method of production as the rubber strippers eliminate distortion of the side walls. Die inserts are also an advantage

really useful for the drawing process as the difficulties encountered in providing some form of ejection and holding for the blanks lifts the press out of the simple easily tooled class of machine and introduces complications more in keeping with the usual class of press tool.

If this final remark is remembered, then the installation of this press or even a battery of them side by side on a bench, makes a worthy addition to the workshop and at a fraction of the cost necessary for the power operated machine tool.

Holes through the side walls of a can or even a channel shaped component, can conjure up a rather elaborate piercing tool because the punches must naturally operate in a sideways direction unless the component in question is small enough in diameter to stand vertically and thus allow the tool to punch them in the orthodox manner, but the condition is apparently aggravated when rows of holes are required, and the larger items make it necessary to arrange either circles of piercing punches or some form of indexing mechanism to position the can in a fresh setting after each descent of the press ram.

However, reflection will reveal that the strippers which are so essential to overcome the tendency of a workpiece being pulled outward as the punches recede, take up considerable room and, what is more, a dozen or so are responsible for a considerable slice of the tooling costs for this operation; thus a reduction either by incorporating another idea or eliminating them completely is a welcome improvement.

Fig. 4 illustrates how to overcome this problem. Admittedly the stripper is still present round each punch, but the design is now so simple yet effective, that the writer has no hesitation in recommending it for almost every type of side piercing tool of this description.

When small holes are to be made in a component, no matter whether just a single hole or a series, the inserted style of punch is essential because eventually a slightly dull cutting edge will result in a fractured member and the replacement cost of a large punch is prohibitive.

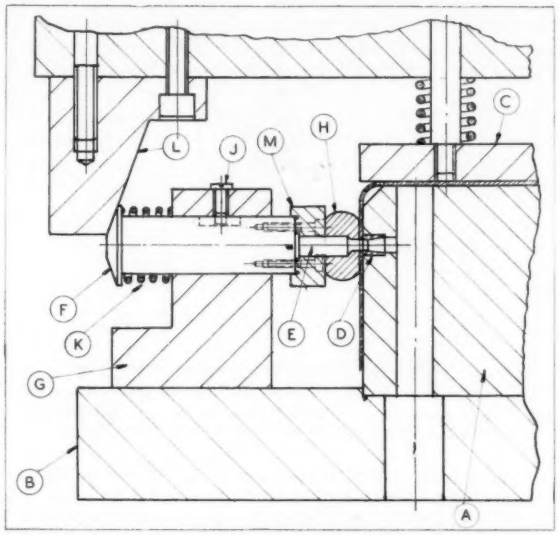


Fig. 5.—Holes close together are best handled with the design shown here. Flanged punches are preferred to those illustrated in the previous example because securing them in this way is easier

Silver steel is a useful material for these small punches E attached to the punch holders F by means of simple grub screws contacting the taper machined on the punches.

The component is dropped on a circular location in the conventional manner and the pressure pad in the upper tool holds it against the top surface of the location as shown by A and B, but as the holes are so small, die inserts are used with the usual clearing hole behind for the falling slugs. The location is set into a recess bored in the bolster B and this is preferable to using dowels because the thrust set up by the piercing tools can be heavy if a considerable number are in action together.

The head of the punch holder is angled to correspond to the angle machined on the punch actuator L—20° is suitable, and as two punches in this instance are moved in unison, a double angle is necessary. The actuators F require to be of a high carbon steel and the sliding diameter and head need case-hardening, but as the bore for punch is small there is no need to carry out this process at that point. Each actuator is prevented from leaving the punch block G as the top tool rises by the retaining screw J which engages with a slot milled in the holder, and a heavy gauge spring behind the head of the latter ensures that the punches withdraw when the press completes the stroke.

The pressure pad is nothing more than a ring of stout rubber surrounding each punch, and the buffer effect is sufficient to prevent a thin walled component pulling away under the action of a withdrawing punch. In practice it is found convenient to use an adhesive to hold these buffers in place—in many cases they adhere tenaciously without an adhesive, but there is always those exasperating one or two pieces that insist on dropping off at every press stroke or so; thus if each piece of rubber is treated as it is assembled this problem should not arise.

Fig. 5 shows the idea adopted when the holes in the workpiece are so close together that it becomes difficult to make a substantial punch holder for each separate punch. Thus they are mounted on a single unit in convenient numbers; in this case two are secured side by

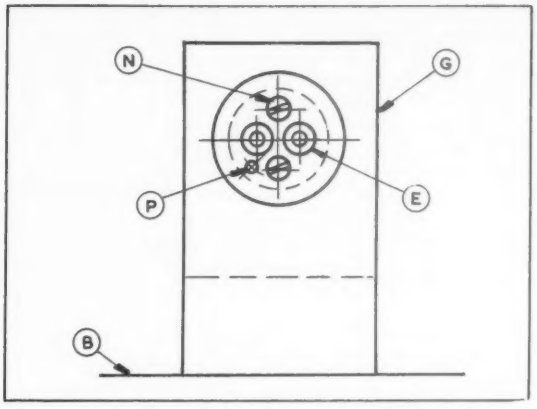


Fig. 6.—End view of the punch showing screws and dowel for securing it to the holder. A tight fit over the latter is essential for secure location

side as shown at Fig. 6, and the design of the punches is changed in order to include a flanged head on each. The punch plate M is recessed to fit tightly over the holder F and screws hold it in place. Again the rubber buffer type of stripper is utilized but a larger piece is usually required because of the presence of two punches. The same application of adhesive is necessary as a precautionary measure.

Whether the component is indexed or punches are arranged at intervals round the periphery as depicted in these examples, does not in any way effect their ability to punch holes without distorting the walls, but if a ring of holes spaced round the diameter is desired, than a circular punch actuator is preferable to placing a series of blocks of the type portrayed here. The ring is cheaper to manufacture and easier and quicker to instal especially if the usual recess is made in the upper bolster as used for locating the component locator.

For any tool of this design incorporating side piercing or notching members which must withdraw before the detail is removed from the tool, heavy gauge springs are essential as they must exert the maximum pressure to ensure that the punches return to their initial starting positions. The press is capable of compressing them even if they are wound from large diameter material, and it is preferable to err on the large side rather than delay production while attempts are made to make a sticky punch slide back from the die. The rubber assists the spring of course, but the chief action is imparted by the latter and these need designing accordingly.

Finally, holes as small as $\frac{1}{16}$ in. have been pierced by this method with only the usual average punch fractures, and the most noticeable point was the complete absence of distortion even on material about 0·015 in. thick.

The disposal of scrap can frequently create difficulties in all forms of tooling equipment and though this does not arise in press work so often as the occasions experienced in orthodox jig production and usage, nevertheless when it does occur it generally means serious and elaborate redesigning before the tool will operate satisfactorily and without constant attention by the operator.

Examples are during the initial stages of making a component on a transfer press, or perhaps a piece of scrap is so large that to allow it to fall through in the usual manner may cause a weakness in the lower bolster, and though there are ways and means of disposing of the unwanted material in the smaller sizes, often for some

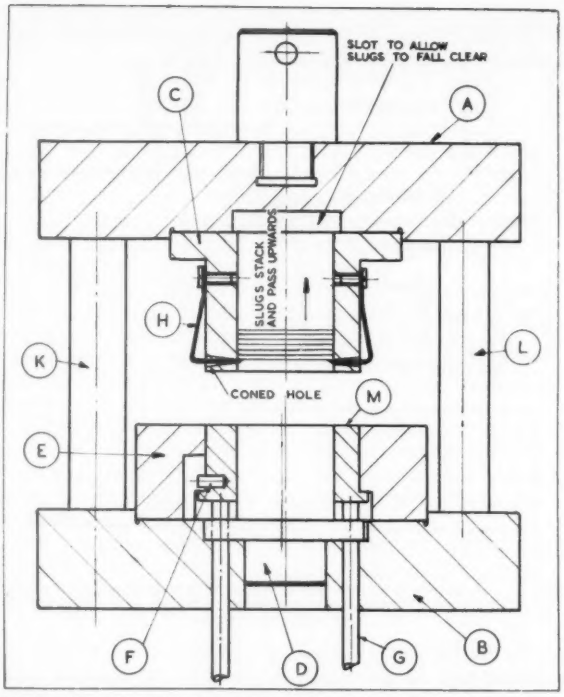


Fig. 7.—Four wire spring pins evenly spaced round the top blanking punch are sufficient to hold a stack of slugs until they pass out of the slot machined in the top bolster

obscure reason an entirely different way of removing the metal is needed. In passing, a brief review of the time-honoured idea of placing a tray underneath the tool is possibly of some interest, and this is incoporated in the lower bolster and is emptied, after a period of operating, into a convenient receptacle. Unfortunately this method has its limitations—a forgetful operator can leave the emptying process so long that the tray becomes choked and the material falling from the tool is retained in the die; stacked material of this nature soon causes the tools to fracture and renders them useless until a major repair has been effected.

A tray underneath the bolster is thus not foolproof, and for the tool illustrated in Fig. 7 it was decided to retain the scrap in the upper tool while allowing the blanked disc to pass along to another tool. The square sheets were located in the usual manner and the pressure plate-cum-stripper held it in contact with the die during pressing: these parts are excluded from the arrangement drawing in an endeavour to show the other details clearly, but they are an essential part of the design and the plate differs from normal in that slots are machined to provide a clearance for the springs that hold the slugs.

These springs which are depicted at H are made from piano wire. There are four of them spaced evenly round the top punch C. As they must move slightly back and forth as a fresh slug is taken into the punch and they must not stick while performing this movement, the punch is drilled and coned to make sure that only a small portion of the hole remains for the pin to rub against.

The drawing shows how the scrap is held by these springs. The blank is severed and is carried down a short distance while leaving the piercing slug on the top surface of the punch D where the springs slide over it

and 'snick' into position underneath. The ends are shaped to almost a sharp point and hardened to prolong their life; thus by carefully regulating the machine stroke to a few thousandths of an inch greater than the position of the blanks, on each descent the springs can just reach under the slug and hold it in the punch. Once gripped there is no likelihood of it again falling downward—even if one spring did not successfully slip under a slug the remaining three are more than sufficient to perform the duty of holding the slug against the pull of gravity.

The slugs stack as each succeeding stroke produces another and eventually the pile is enough for one to fall through the slot machined in the top bolster. An inclinable press is an asset in assisting this removal and generally the pieces fall away without difficulty, but in the event of very thin stock, and the latter is sometimes awkward if a slightly greasy surface is encountered, then a form of spring loaded mechanical ejector is advisable, and if this is attached to the upper bolster A, each rising slug is automatically knocked off the top of the stack.

The drawing shows the spring points protruding into the piercing punch a considerable distance. This exaggeration is only to show them clearly as a mere five thousanths of an inch is ample to retain the scrap if the points are kept sharp and not allowed to chip or become blunt. Any distance greater than this means the springs must have excessive movement each time a stroke is made and there is also the risk of their scratching the sides of the slugs and so making them just that much tighter inside the punch—a situation that can prevent the springs from operating and the scrap being left on the surface of the punch.

Occasionally the top ejector in a press tool can create a minor difficulty, especially when the tool is transferred from one machine to another, or if the problem of length arises when the tool is being used in a contract press shop. Such situations demand that the simple rod type of ejector be replaced with one that is adjustable to overcome the exasperating situation of finding that a rod is about an $\frac{1}{8}$ in. too short for the satisfactory ejection of a shell.

Unfortunately, many of the plain ejectors are made too small to allow of the simple modification shown in Fig. 8; thus on all occasions, even when an adjustable

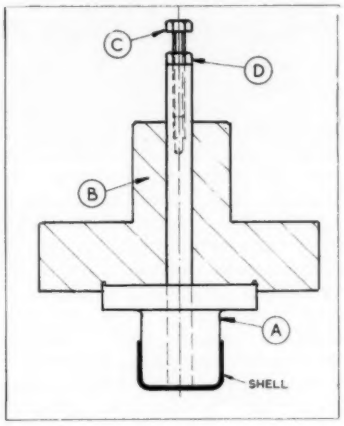


Fig. 8.—A simple modification to allow the length of a plain ejector to be adjusted to suit the tool. A, punch. B, punch holder. C, screw. D, locknut

member is not deemed necessary, an increase in the diameter to allow the use of a screw and nut at the top will cater for all eventualities.

Case-hardening the nut and bolt head is a wise precaution, and the tapping of a deep hole with a very long bolt ensures that while so much adjustment is seldom necessary, nevertheless the isolated instance is successfully dealt with without having to search around for a replacement.

Variable and Continuous Pipe-Line Mixer

The introduction of a motorized pipe line mixer which speedily and efficiently mixes fluids as they flow through a pipe-line, is claimed to dispense with the need for large agitating vessels. Developed by Wm. Boulton Limited, Providence Engineering Works, Burslem, Staffs, the Thrumix continuous pipe-line mixer is manufactured in a range of sizes from 1 up to 6 in bore in cast iron, stainless steel or non-ferrous metals.

Sectional view of the Thrumix continuous pipe line mixer showing turbo rotors, emulsifying cage and stuffing box

The principle employed offers a very high degree shear and an easily obtained controllable degree of recirculation. The small horse-power motors used, ranging from $\frac{1}{3}$ to 2 hp, depending on the requirements, represents a considerable power economy. On low viscosity materials the through-put is approximately 14 gpm, increasing to a maximum of 400 gpm. Two models are available; the first with a fixed degree of recirculation, and the second with means for axial movement of the stator cage, which allows varying degrees of recirculation and controlled shear, a feature claimed to regulate the degree of mixing and blending depending upon materials being mixed.

The Thrumix units range in price from £60 to £140.

Flywheel Impulsed Screwdriver

An Archimedean screw type screwdriver with a flywheel sleeve to provide additional torque to the bit is claimed highly effective in loosening the tightest screw. Once the bit is engaged in the head of the screw

He-Man flywheel assisted ratchet screwdriver

a push on the handle sets the flywheel spinning. When it has reached maximum speed and power dogs engage with the bit and impart maximum torque to the screw. Having loosened the screw the ratchet unscrew mechanism is engaged and the screw withdrawn. For driving screws home the mechanism is reversed and the procedure repeated.

The He-Man is manufactured by C.M.I. Products Limited, Finchley Road, Hampstead, NW3, and adapters are supplied with the tool for tightening set-screws.

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Power Handling of Heavy Hose Pipes

At the Esso Refinery, Fawley, new installations have been built which have improved the technique of hose-handling and resulted in a faster turn round of tankers. Foster Wheeler Limited, the main contractors engaged in extension and modernization activities at Fawley, have been responsible for this new construction in conjunction with Woodfield Rochester Limited, to Esso specification. The equipment includes a large number of hoists and winches which are powered by Holman reversing air motors remote controlled by Maxam pneumatic equipment. This development has demonstrated the versatility of compressed air equipment and the efficiency resulting from its use. With bigger pipe lines and ship-to-shore hose connexion, compressed air provides flexibility of operation and safe working; the absence of fire risk; and if an air motor should stall due to overloading, it cannot burn out, and if used correctly it is completely reliable under all operating conditions.

The largest of the new installations at Fawley is a boom controlled by an air winch which supports heavy, large diameter flexible hoses for ship-to-shore connexion and, whatever the position of the tanker manifold, the connexions can be easily made. This is possible by luffing the boom which supports the hoses, and the incorporation on the boom itself or air hoists which can be traversed horizontally. All movement of the tanker is easily compensated by the combined movement of the boom and air hoists.

All winches and hoists are reversible and are controlled by Maxam neutral position lever valves, located on a control panel placed in a strategic position on the jetty, and operated by one man. The Maxam panel directs the movements of nine Holman air hoists and also the raising and lowering of a 13-ton boom luffing winch. The boom carries five pendant trolley hoists, all of which are independently controlled from the panel for left and right movement on air motor driven travelling mountings. A pendant trolley hoist mounted on the outward member of the boom supports half a ton and traverses the width of the boom. Further positioning control for each hose is provided by interposing between the hook at the end of the hoisting line and the hose an air cylinder hoist which can be inched over 3 ft to ensure the final accurate positioning of the hose for connexion to the tanker manifold. This air cylinder is controlled by a push-button valve located on a short length of pneumatic hose attached to the cylinder and fed from the air supply on the jetty. Placed inward of the ½-ton hoist on the boom are two hoists which support 2 tons each for handling bunker fuel hoses of 8 in. dia and two 6½-ton hoists for handling the 10 in. dia crude oil hoses.

Mounted on the main structure are four pendant hoists placed in line parallel to the edge of the jetty. To control the middle sections of the 10 in dia flexible hoses, two 6½-ton hoists are placed as the middle hoists of the line of four, while two outer hoists of 2-ton capacity handle the lighter hoses.

These four hoists work in conjunction with the traversable pendant hoists on the luffing boom, and are able to support combinations of hoses which are linked together by the use of bridles. This system allows a larger number of hoses to be presented to the tanker manifold simultaneously and in line.

Placed to each side of the main hose-handling structure are two bunkering derricks, each of which employs a Holman luffing winch and a lifting hoist. Both hoist and winch are Maxam controlled and the working load is 1½ tons.

To handle coastal tankers four smaller hose-handling units have been built. Each unit consists of a structure which carries two separately controlled hoist and derrick combinations. Holman air motors and Maxam control equipment are again used on these installations. On the jetty at one side of each structure a Maxam control panel operates a 2-ton Holman trolley hoist which raises and lowers the hoses. In addition the panel controls a 2½-ton

With this equipment heavy hoses are handled and accurately positioned for coupling to the ship's manifold by means of the air hoists on the luffing boom. Movement of the boom and control of all the raising and lowering of hoses is done by pneumatic power under the control of one man

derrick luffing winch and a 1-ton hoist on the jib used for passing the hoses out and over the side of the jetty so that connexion with the tanker manifolds can be made. An identical control unit is situated at the opposite side of the main supporting structure.

Saving Space in Boring Large Frames

Wherever heavy plant is produced the storage and movement of large fabricated parts present a serious problem, and any saving of space that can be effected must be considered well worth while. The Rugby factory of A.E.I. Heavy Plant Division is regularly engaged on contracts for the supply of heavy electrical equipment including hydro-electric generators, ship propulsion motors and motors for rolling mills. Not only are many of the components themselves very large, but the machine tools required to perform the various production operations are also necessarily of a considerable size and occupy a great deal of valuable floor space.

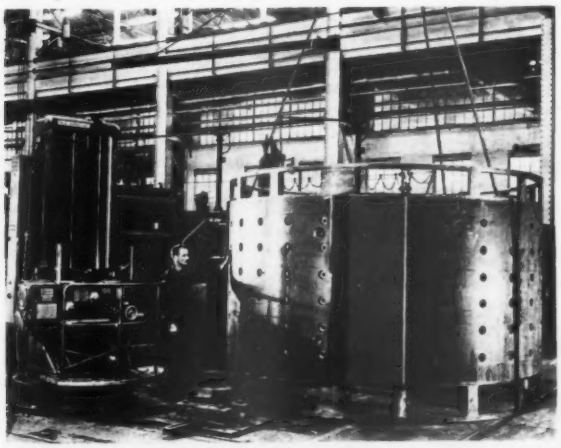
Among the parts which must be machined are the magnet frames for large d.c. motors and generators, ranging in size up to about 15 ft internal diameter and 7 ft long. The frames, after being bored and faced are drilled radially to receive the bolts which secure the pole pieces. For drilling the holes the division has recently installed a Swiss "Rigid" transportable, drilling, boring and milling machine Model BR 500. The machine has been specially developed for working inside cylindrical work-pieces having internal diameters from 59 in. to 197 in. Whilst the machine is in operation inside a magnet frame it obviously takes up no additional floor space, and when the machine is not in use the floor space occupied is only 53 in. × 53 in. It can be moved from one part of the factory to another, thus achieving the maximum possible usage both of the machine and of the available floor space.

Either of two methods of working can be adopted. The machine can be left in place and the magnet frame lowered into position round it, or alternatively, when a large number of frames are to be handled and floor space is fully occupied, it will be preferable to lift the machine out on completion of the operation and lower it into the next frame on which work is to be carried out. With the machine removed, assembly work can be carried out without moving the frame: this would not be possible if stationary machines were employed.

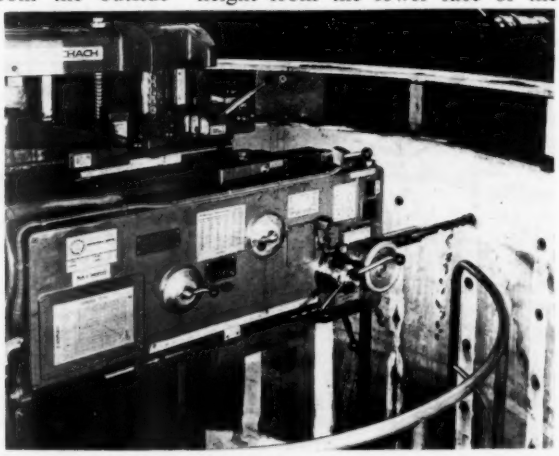
The illustration shows a magnet frame of 149½ in. outside and 133½ in. inside diameters for a 3000 hp motor for a twin-motor rolling mill. There are 14 main and 14 commutating pole-pieces spaced alternately round the inside of the frame, each being secured by a row of six bolts. The holes for securing the main poles are 1¾ in. dia, counterbored 3½ in. dia by 1¾ in. deep on the outside to receive the bolt heads, and those for the commutator poles 1½ in. dia, counterbored 3⅛ in. dia by 1½ in. deep. The tolerance on centre distance from a datum hole is 0·10 in. Counterboring is done by running the boring bar through the drilled hole, inserting the boring tool from the outside and engaging reverse feed. Owing to the curvature of the outside diameter the initial cut is intermittent, necessitating a fine feed. Tapping and milling can also be performed.

The base of the machine is provided with a circular table which can be centred. The column can be rotated through 360° by hand feed or quick power traverse, and can be set at any angle by means of a micrometer-adjustment and clamped in position. The spindle can be adjusted to any radius between 29½ in. and 98½ in. The spindle carrier can be moved vertically through a distance of 59 in. by hand feed or power traverse, the minimum spindle height from the lower face of the

DUST CONTROL IN THE FOUNDRY.—This view of part of the fettling shop in the Manchester works of the Metropolitan-Vickers Electrical Company Limited shows the method used for removing harmful respirable dust from the breathing area of the operator. The low volume, high velocity system is particularly important because of the extensive use of high speed portable power tools such as sanders, grinders and cutting-off wheels which create large volumes of dust in foundry fettling shops, engineering works etc. The system is that of the Dustructor Company Limited (a member of the Holman Group, Camborne, Cornwall) and operates by attaching an extractor to the hand tool near the source of the dust. A suction is created by a high speed turbo-exhauster 5 in. Hg, which extracts approximately 35 to 40 cfm of free air through the extractor head and a ⅜ in. dia flexible hose taken to a filter unit.



Comparison with a magnet frame of 149½ in. dia emphasizes the compact dimensions of the transportable drilling, boring and milling machine



The transportable machine drilling radial pole-piece attachment holes from the inside of a magnet frame of 133½ in. dia

circular table being 31½ in. A noteworthy feature is the longitudinal displacement of the entire spindle carrier up to 27½ in. Axial movement of the spindle sleeve is 7⅞ in. and of the boring spindle, which is 2 9/16 in. dia, 17¾ in.

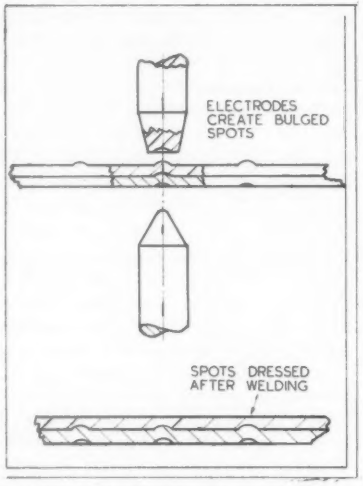
Power is derived from a two-speed flange-type motor of 5-6 hp mounted in the spindle carrier which is a one-piece closed type casting. Lubrication of the spindle carrier is automatic. There are 32 spindle speeds from 9·5 to 1356 rpm and 20 boring and fast feeds from 0·12 in. to 7·85 in. per min. There are also 20 vertical and horizontal milling feeds from 0·35 in. to 23·6 in. per min. All controls are within easy reach of the operator who stands on a platform which is raised, lowered and rotated with the spindle carrier. The overall height of the machine is 124 in. Its net weight is approximately 12,800 lb.

Dowding and Doll Limited, 346 Kensington High Street, London, W14, are the U.K. distributors for Swiss "Rigid" machines.

Eliminating Spot Weld Marks

Surface finish is an important aspect of production in many articles thus any effort that either eliminates or reduces the amount of necessary work prior to painting or perhaps plating, is worthy of serious consideration especially when extensive hand work is overcome, and spot weld marks can feature in many of these problems.

In one high-class instrument the operation of peening the inside of the weld to create a slight bulge so that the weld mark could be removed by grinding meant that this treatment for a dozen or so spots occupied a fair amount of a skilled fitter's time. This peening process was eventually eliminated by redesigning the electrodes as illustrated in the top half of the sketch because the bulge is created during the welding operation and adjustment of the electrodes, if carried out with care, raised the material enough and somewhat more precisely than is obtained by using a peening hammer.



A simple modification to the electrodes of a spot welder can produce a slight bulge on the surface which is easily cleaned off. A smooth outer surface is then obtained as shown here without the usual lengthy peening operation

The resulting bulges are then easily and quickly removed by grinding either locally or by skimming the surface where several spots are clustered; the result being as shown in the bottom half of the sketch—a perfectly flat and clean surface.

Automatic Feeding Device for 250 ton Press

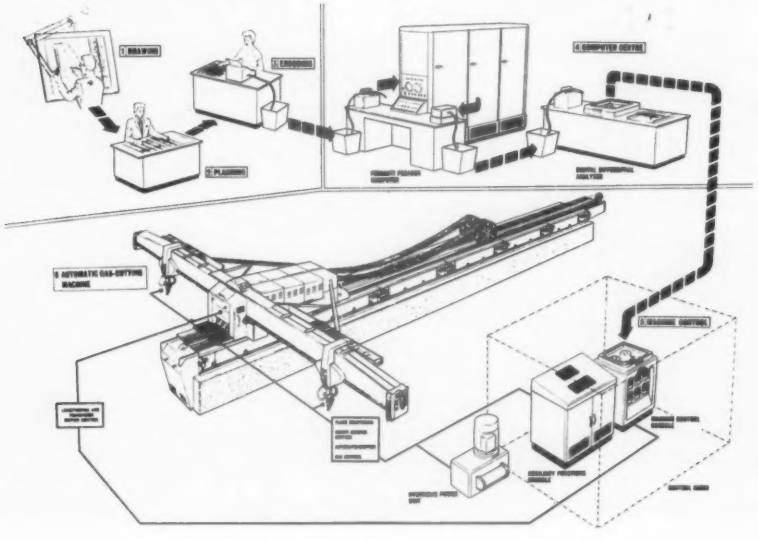
In a new production line recently put into operation at the Ford Motor Company Limited, Dagenham, flat steel bars 45 ft to 60 ft long are transferred by crane direct from the rolling mill in stacks 20 in. high, and automatically loaded one by one into a 250-ton punching and cropping press. The press, supplied by Cowlishaw, Walker & Co. Limited, Biddulph, Stoke-on-Trent, is provided with adjustable tools for cutting and punching slightly different sections of bar to produce lengths adjustable between 5 in. and 5 ft. The tools have twin tracks so that two stacks of bars may be fed together.

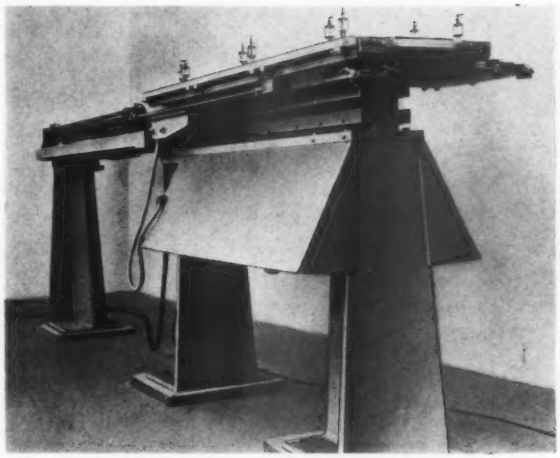
The loading device consists of a pair of motor-operated screw-jacks, some 3 ft back from the leading edge of the stacks, which independently lift the whole front section of each stack up to a fixed height, where the top bar lies between gripper jaws.

Each lift is started by push-button from the control panel, but switches itself off automatically when the correct height is reached. The controller then closes the gripper jaws by push-button, and at the same time they move forward to introduce the free end of the top bar between powered rollers. The grippers are then released and the powered rollers carry the bar over some 8 ft of tool change space and through the 5 ft of press tool equipment in the press.

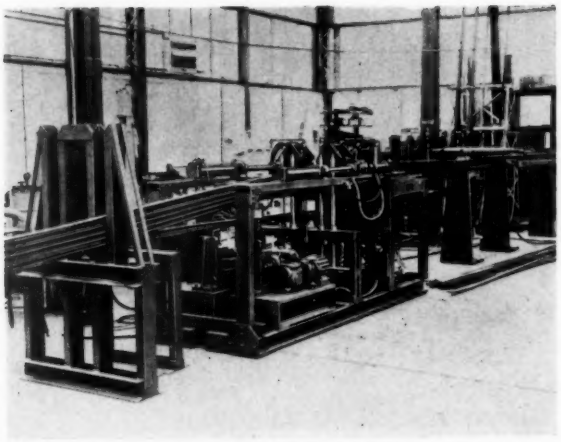
As soon as the leading edge appears beyond the cropping tools, the controller releases the roll feed and the press is operated once to crop the rough bar-end square. At this stage an automatic twin gripper feed mechanism comes into operation

COMPUTOR CONTROLLED PROFILE CUTTING MACHINE.—A Ferranti Pegasus computor in conjunction with a differential analyser is here shown controlling the profile cutting machine, developed by British Oxygen Gases Limited, which was mentioned in "technique" last month. From the dimensioned drawing the job is planned and the co-ordinates of each point of change, the types of curves and the cutting speeds are coded on tape. The code is read in the computor centre where the movements of the cutting heads are calculated in terms of machine slide distances and recorded on magnetic tape. This tape is then played back in the machine control circuit from which servo-mechanisms operate movement in the machine





Twin sets of grippers pull the bars through the tools to fixed length stops automatically tripping the press for the next power stroke



Bars from twin stacks up to 60 ft in length are power-loaded into the machine by means of the stack feed half of the equipment

the gripper jaws automatically advancing to seize the bar just inside the press tools and pull it to a fixed stop which measures off the length to be cut. When the stop is reached, the press is automatically tripped to crop off this length and the bar falls away into a bin. The grippers then return automatically to repeat the operation, which carries on until the whole bar length has been used up, when the loading mechanism is again activated to introduce the next bar.

The use of long bars straight from the rolling mill eliminates the cost of intermediate cropping and a number of manual handling operations. The automatic gripper feed gives high rate of production with no risk to the controller, who is situated at the side of the machine out of reach of the tools.

To adjust for different cut bar lengths the stop on the gripper feed mechanism may be moved by slackening two T-bolts and re-tightening. No other adjustments are necessary on the feed mechanism. The bar loading mechanism will handle the whole range of bar sections and lengths without adjustment. The jaw mechanism at the loading end is arranged on a swivelling bridge so that it may be manually swung out of the way for loading a new stack of bars by the crane. No tools are required for this operation.

The loading and automatic feeding mechanism was designed and manufactured by The Hymatic Engineering Company Limited, Redditch, Worcs., and the electrical control equipment linking the press with the feeding mechanisms was evolved jointly by Hymatic and the press makers, and manufactured by Square D Limited.

Mechanical Power from Vaporizing Liquid Gas

Gases such as oxygen, nitrogen or methane are usually transported or stored in large quantities in their liquid state and the refrigeration available in these liquid gases is destroyed when the gases are vaporized into pipe lines for supplying industrial plant: heat, either from an electrical store or from steam, usually has to be supplied for this purpose. An invention which British Oxygen Research and Development Limited has patented (No. 808535) utilizes this refrigeration to produce mechanical energy.

In the process the gas is compressed in the liquid state to a pressure well above that required at the gas delivery point. A natural heat store, such as the atmosphere or a river, supplies heat to the liquid gas which is then expanded in a turbine or reciprocating expander. The expanded gas is then further warmed to about room temperature by means of the natural heat store. The work required for the purpose of compressing the original liquid will only be a small fraction of the total produced in the expansion engine and the balance will be available as free mechanical power. This can be used for any suitable purpose, e.g. for the production of electrical energy.

Fuel Centrifuge

Further equipment has been added to the Firth Cleveland Fuel Flow Test House at the works of Simmonds Aerocessories Limited, Treforest. The installation, which comprises a De Laval 100 cc "Precision" test tube centrifuge with ancillary equipment, is one of the largest of its kind in this country and Europe.

The centrifuge, which develops 10,000 g, will be used for measuring water content and sediment in the effluent aircraft fuels from water separators and filters. It has already proved its value in a series of tests designed to show that Simmonds separator conversion kit No. N396 converts various types of woodwool or "Hay-tank" separators for use with JP4 fuel, in accordance with U.S. Military Specifications.

The centrifuge develops approximately 20 times the centrifugal force of the standard centrifuges referred to in the A.S.T.M. test (10,000 g). The most stubborn emulsions can be broken and extremely fine colloidal dispersions are readily separated. The machine is brought to full speed (6,000 rpm) in 75 seconds. Its head accommodates four 100 cc test tubes having elongated tips permitting readings down to 0·001 % or less. Test samples can be run under controlled temperature conditions.

General view showing the coils of grain-orientated steel ready for processing

The strip is here passing through the slitter line

Manufacture of Transformer Laminations

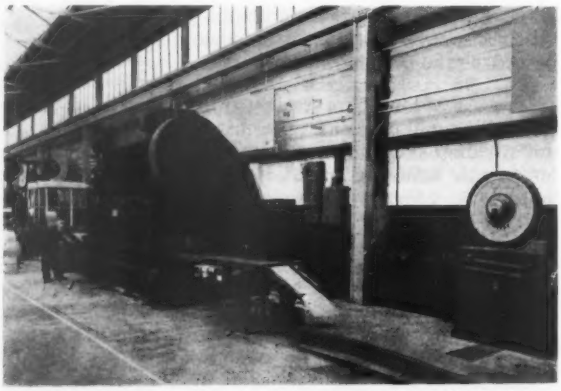
Transformers have been much improved by the introduction of cold-reduced grain-orientated steel, but this material requires special processing to secure its beneficial magnetic properties. A new installation for the purpose is described

SUBSTANTIAL improvements in the efficiency of transformers and reductions in the overall sizes of these machines have become possible with the introduction of cold-reduced grain-orientated steel (usually called "C.R.O.S.") in place of the hot-rolled silicon steel commonly used throughout the transformer industry for the past thirty years.

Until recently C.R.O.S. has been available only in sheet form. The cutting of laminations from sheets is uneconomic since the length of the finished laminations rarely coincides with the length of standard sheets, and considerable wastage therefore ensues. Since C.R.O.S. is appreciably more expensive than hot-rolled steel, the wastage is of even greater significance. The principal British core-steel manufacturers have therefore installed the necessary plant to make C.R.O.S. available in large coils, which with proper equipment, can be cut and processed more economically than sheets.

The properties of the new material (in particular, it has a magnetic reluctance much lower in one direction than in any other) have made it necessary to evolve new core constructions to use it to the best advantage. Also C.R.O.S. is very sensitive to the mechanical strains inherent in piercing and cutting operations and in consequence stress relief annealing has become an essential manufacturing process.

In order to make full use of the advantages of C.R.O.S. The British Thomson-Houston Company Limited has built and equipped a completely new factory for the production of transformer laminations and cores. Well-lit and spacious, the new factory has a main bay 400 ft long, and a side bay for the annealing and insulating furnaces. The total floor area exceeds 30,000 sq ft. The equipment in the factory was principally designed to produce laminations from coiled steel, but can also handle sheet when necessary.

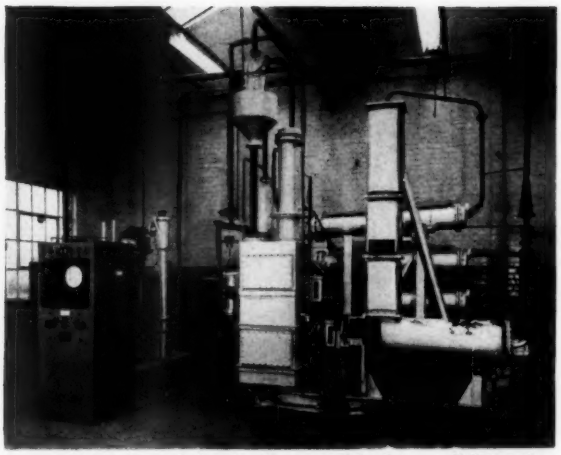


The piercing and cutting l ine, where the strip is cut to size and punched for laminations

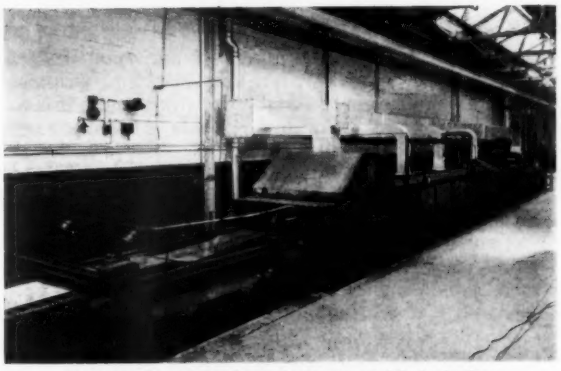
The core steel is received from the supplier in coils 30 in. wide and up to 5 tons in weight, and stored separately in appropriate grades. The first operation is to slit the wide coils into the narrower widths required for laminations. This is done on the slitter line, each width being re-coiled ready for the piercing and cutting lines. The slitting cutters can be adjusted to cut any required width and a number of widths can be cut at one time. Special care in the design, setting and maintenance of the cutters minimizes edge burrs.

The piercing and cutting line consists of a coil holder and decoiler, a combined press and guillotine, and a discharger. On this line, a coil of material of the correct

This conveyor-type stress-relief annealing furnace was the first of its type in Europe, having many advantages over conventional "batch"-type furnaces



Automatic plant for producing the nitrogen used in the controlled-atmosphere furnace



Flash enamelling furnace for the final treatment of the laminations

Special side-loading truck for the transport of transformer laminations

width for the laminations required is mounted at one end. The strip is fed into the combined press and guillotine which pierces and cuts each lamination to length in a single operation. This ensures close dimensional accuracy. After cutting, the laminations are automatically stacked and weighed.

Stress relief annealing is of great importance if full advantage is to be obtained from the special properties of grain oriented steel. The equipment, which has been used successfully by BTH for a number of years, is of the continuous furnace type having two heating and a number of cooling zones. Laminations are carried through the furnace on a slow-moving belt. Within the furnace is a controlled neutral atmosphere of dry nitrogen produced by an automatic plant. The dry nitrogen is fed into the furnace at a slight pressure which forces the air out at each end. This annealing process has been proved to give substantially the same results with mass-produced laminations as samples batch-annealed in the laboratory.

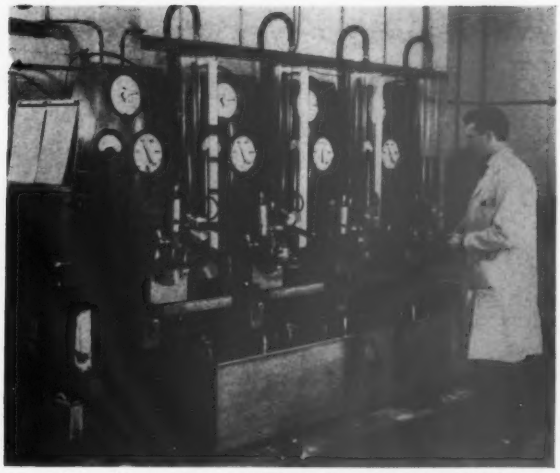
The standard final finish for BTH transformer core laminations is a flash enamel applied to both sides and all edges after all other manufacturing processes are complete. The enamel is a Class B (heat resisting) insulant of high dielectric strength. In the flash enamelling plant, laminations are first passed through rollers which coat them liberally with varnish in liquid form. They are then transferred automatically to a moving metal belt which carries them through a flame zone in which the varnish is baked hard. After passing through a cooling zone, the laminations are loaded into special pallets arranged to avoid unnecessary handling before the cores are built.

Great emphasis is placed on maintaining all laminations flat once they have been annealed, and a special rubber-tyred side-loading truck is used to transport the pallets of laminations from the lamination factory to the core building areas.

With production based on rapid flow principles, it is essential to have some reliable system of production checking. Apart from routine inspection and dimensional checking by wholetime inspectors, the company make the following tests on a systematic basis:

(a) Regular samples are taken of the steel as received from the makers. From each sample, strips are cut and annealed for testing as standard Epstein squares.
(b) Daily samples of insulated laminations have the insulation value of the flash enamel checked on a Franklin tester.

Further additions and improvements in equipment and technique are constantly being instituted, for as the core is the basic constituent of a transformer therein lies one of the most promising fields for the advancement of transformer design and manufacture.



A general view of the pump life test rig in the development laboratory of the Industrial Hydraulics Division of The Plessey Company Limited showing four 20 hp heads

At right is a rear view of the new mobile research unit with doors open, boom retracted. The circular plate beneath the rear frame covers the power take-off shaft when not in use

Industrial Hydraulics Research

The development of hydraulic equipment requires specialized equipment. A new laboratory for the purpose is described which has an essential auxiliary, a mobile unit for making tests under operating conditions

THE marked increase in the use of hydraulic mechanisms for power assisted and automatic controls has created many problems of unit and system design. As a result, the Industrial Hydraulics Division of The Plessey Company Limited has built a development laboratory at Swindon which, together with a mobile research unit, is devoted entirely to solving problems of this type.

The work carried out by the development section of the engineering department working within the development laboratory is in two parts: that of normal prototype development and that of extended running for life-testing of the units under test before release for production. The laboratory is equipped to test all types of hydraulic equipment such as pumps, hydraulic motors both positive displacement and variable displacement, valve gear and rams. For convenience, the life test section is confined to a separate part of the building, whilst the main part of the laboratory is concerned with prototype equipment.

The various rigs contained in the life test section are of a partially set form of construction, allowing little variance of layout, whereas the rigs in the development section have been laid down with a view to maximum versatility.

The total machine capacity in the prototype section amounts to 275 hp, consisting of three 75 hp dynamometers and two 25 hp dynamometers. Two of the 75 hp dynamometers can be coupled to form one machine giving 150 hp, and the two 25 hp dynamometers can be coupled in a similar manner to give 50 hp. The dynamometers are housed in brick encasements projecting into the interior of the laboratory, thus reducing the noise level to a minimum. These units operate at speeds of 0–3000 rpm with the power proportional to speed and 3000–5000 rpm with full power available. The main controls of the dynamometers are suitably positioned immediately in front of observation windows in the encasement. Drives from the motors are taken through the walls by suitable shafts running in ball and roller bearings and terminate in a flange and housing arrangement of standard design. These machines are driven from motor generator sets comprising a.c. synchronous motors driving d.c. generators.

Motor rigs in the life test section are of the fixed speed type. A single unit of 75 hp may be used in conjunction with a gear box enabling up to four pumps to be run from one unit. This rig is used for general life testing of pumps and as a source of fluid power for life-testing of control valves and auxiliary hydraulic equipment. A single 30 hp fixed speed motor is arranged to transmit power to its drive head through a V-belt and pulley mechanism. This allows some variation in the final output speed. The normal pump life-test rig consists of an assembly on

The mobile research unit of the Industrial Hydraulics Division of The Plessey Company Limited carrying out a field test on a light tractor. During these tests the research unit was sometimes heeling over as much as 45 degrees

which four 20 hp motors with individual drive heads are mounted side by side. There is also a ram life-test rig consisting of a heavy structure frame on which is mounted a slave loading ram and the ram to be tested. All the rigs contained in the life test section are adapted for use with automatic control gear in order to give 24 hr running without attendance.

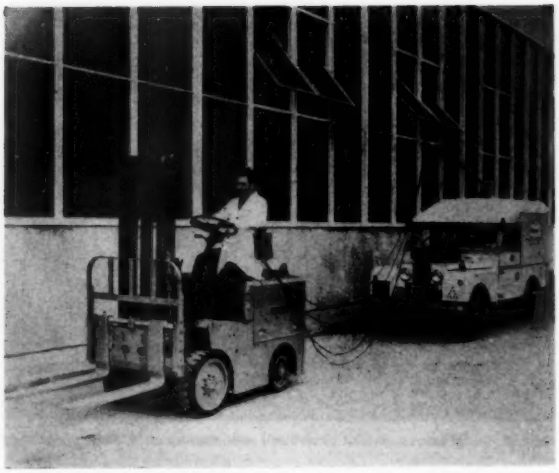
As the hydraulic fluid varies considerably with the application, portable tanks are used in the prototype section. Built into these tanks is a flow measuring gear either of the cylinder measuring variety, or the standard electronic flow measuring unit incorporating a positive displacement flow meter. Fluid tanks are also provided with immersion heaters and radiator cooling systems to maintain control in the temperature of the test fluid during operations.

As it is becoming increasingly more difficult to measure and inspect component parts of hydraulic units, a section of the laboratory is devoted to the housing of precision measuring instruments. The present installation in this section comprises an optical projection unit for the examination of machined forms against master plans, and a Talysurf surface measuring apparatus on which both surface measurements in terms of centreline average and actual indicated forms by the use of graphical reports can be obtained. A binocular microscope is also available and is utilized for examination of macro structures. It is planned to install a precision measuring machine capable of determining sizes to 0·00001 in.

In order to assist in the preparation of reports from which maximum benefit can be derived, a section has also been converted to a photographic dark room. Equipment in the form of a half-plate camera, lighting equipment of both floodlight and flash types, together with processing equipment, is used for producing photographs of points of interest of a particular component under test where it is essential that a visual examination is portrayed.

The laboratory has a total floor area of approximately 4000 sq ft.

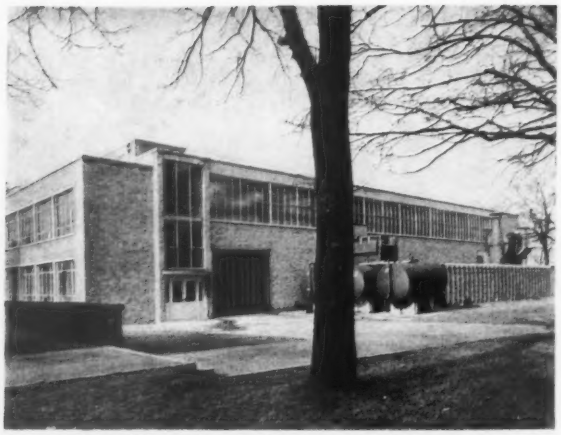
As a result of the adaptability of hydraulic control, increasing use is being made of hydraulic systems on mobile equipment. The efficiency of a hydraulic circuit requires the measurement and recording of pressure and fluid flow parameters. Previously it had been considered satisfactory to determine the performance of hydraulic circuits by the usual laboratory tests, but it has been found by experience that all the conditions under which



A typical test hook-up for industrial fork lift truck tests by the mobile research unit of the Industrial Hydraulics Division of The Plessey Company Limited

a particular circuit is required to work cannot be satisfactorily simulated on a test rig, with the result that the only foolproof way to undertake these tests is to measure the parameters with the hydraulic circuit at work in its designed application. In order to do this the company has converted a Land Rover into a mobile research unit and has fitted the vehicle with all the necessary equipment to enable the required parameters to be measured. The power take-off unit has been adapted to provide power for individual testing of hydraulic pumps in the field. The measurements of pressures are monitored by electrical transducers giving a voltage output as a function of the pressure and displayed on oscilloscopes in the research unit. To allow freedom of operation to the machine under test it is necessary that recording equipment and the vehicle in which it is contained be positioned at a distance from the test vehicle. This requires the use of considerable length of cables from the transducers fitted to the test machine to the oscilloscopes in the mobile research unit, thus requiring the use of a pre-amplifier in order to get signals of sufficient strength for transmission via connecting cables. Two oscilloscopes are mounted on anti-vibration supports within the research unit, each with two independent channels with d.c. amplification. For recording purposes 35 mm film cameras are attached to these units, the cameras being driven by electric motor through a 9-speed gear box, allowing film speeds from 0·05 to 25 in. per sec. The electrical power for the oscilloscopes and cameras is obtained from a 1 kW a.c. alternator driven by a single cylinder four stroke petrol engine. The unit is governed to maintain constant voltage output. For processing the film, a box incorporating light trap plastic sleeves allow the operator to transfer the length of film from the camera casettes to the developing reel, with the use of a reel loading unit. A portable film drying unit is also carried, the power supply for which may be obtained either from a mains electrical supply or from the motor generator set in the research unit.

For extended operation a further cable is carried to the research unit and the machine under test. This enables two-way communication between the drivers of the two machines by means of microphones and microphone head sets.



General view of interior of pilot plant block with one-fifth scale model of continuous pusher type reheating furnace in foreground. Right, exterior of the new pilot plant block

Pilot Plants for Steelworks Research

The latest addition to the Swinden Laboratories of The United Steel Companies Limited contains pilot plant models of steel melting and reheating furnaces. Three one-fifth scale units have already been built for research on heat transfer at operating temperatures. Later it is intended to investigate recirculation in open hearth furnaces

A LARGE, self-contained building for pilot plant studies has been completed recently and is now in operation at the Swinden Laboratories, Rotherham, of The United Steel Companies Limited. At present it is primarily engaged on fuel and furnace research, and three combustion rigs have been constructed, consisting of a flame tunnel and scale models of an open hearth furnace and a pusher type reheating furnace.

When the laboratories were first built in 1952 there were four main blocks, one of which was divided into a machine shop and development bay where tests could be made on relatively large-scale equipment. During the last few years almost all the space in this bay has been absorbed by permanent equipment, notably three induction melting furnaces, a vacuum melting furnace, a rolling mill and a number of furnaces used for specialized tests on refractories. To provide space for pilot plant work on a substantial scale, therefore, it was decided to build the new, fifth block.

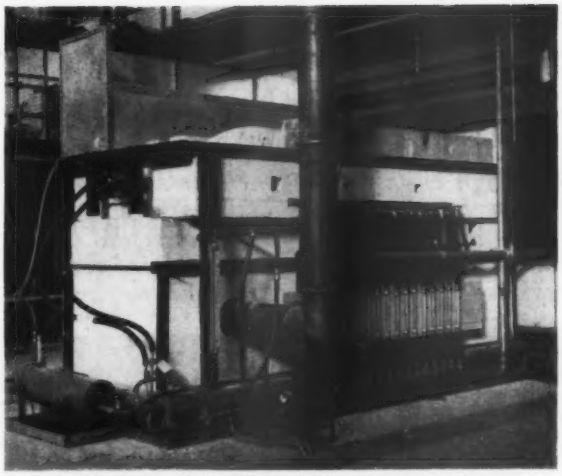
Over the last decade a great deal of pioneering work has been done at Swinden Laboratories on the aerodynamic aspects of furnace design. This has provided a background of science in relation to which new designs can be considered, but like all research it has raised new questions, the answers to which can only be obtained by further study.

Fairly detailed information is now available on flow pattern and mixing in many types of furnace, but research at operating temperature has for the most part been limited to work on full-scale open hearth and reheating furnaces or co-operative tests in the International Flame Research tunnel in Holland. Most of the urgent questions demand the precise measurement of heat transfer which, if made on actual furnaces, would involve a vast expenditure both of time and money. By making possible the testing of one-fifth scale furnaces at full operating temperatures, the new laboratory should not only enable such information to be obtained at a fraction of the cost but with a far closer control of such variables as fuel rate, air supply and thermal loading.

The new laboratory, which is now operational, provides four "stations" for major pilot rigs and additional areas for other work. Service pipes for gas, water, oil and steam, are installed in an under-floor walkway tunnel running along one side of the building. Floor trenches across the bay permit distribution to individual rigs without obstruction. Electric power is available from a continuous bus bar trunking system running along the sidewall with tap-off points at 2 ft intervals. Other services, e.g., hot air, compressed air and circulating water, are located on the opposite wall with tappings at convenient points.

Opposite each of the "stations" is an opening in the wall, covered with sliding doors and leading into a courtyard enclosed by a 10 ft high wall of novel construction, lined on the inside with hollow concrete blocks. This is designed to minimize noise from the combustion rig exhausts which will normally pass through the door openings. On dismantling a rig, the station can be readily cleared of all temporary service piping.

The building is of steel portal frame construction and comprises a main bay serviced by a two-ton crane, a ground floor laboratory, three first floor offices, an



One-fifth scale model of a 100-ton, cold charged, open hearth furnace

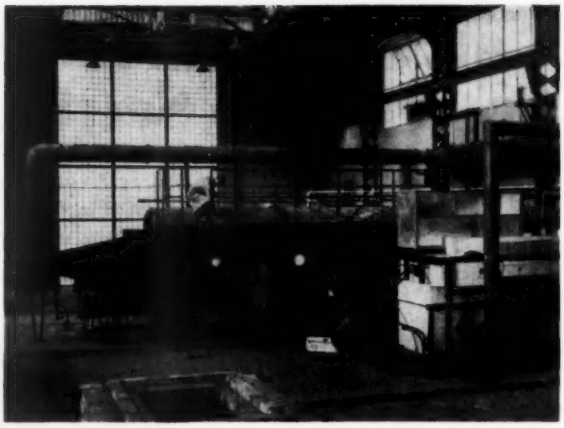
Close-up of open hearth furnace model, showing the calorimeter hearth

entrance with toilet facilities, a basement for the central heating boiler, an air compressor basement and an open yard. The principal dimensions are:

Main bay—length 135 ft, width 47 ft, and height 26 ft.
Main floor area—6300 sq ft.
Ground floor laboratory area—600 sq ft.
Amenities and office area—1000 sq ft.

Fuel oil is stored in three external tanks, each of 2500 gal capacity and individually sufficient for a day's operation at the maximum anticipated load of 100 gal per hr. The oil is pumped to the rigs through pipelines in the under-floor duct system, final temperature control being by means of individual electric line heaters. Town's gas is also available, though in more limited supply.

To enable actual furnace conditions to be simulated more closely, hot air is provided at a temperature of up to 700° C from an oil-fired air heater of 150,000 cu ft (NTP) per hour capacity. The oil can be atomized by means of compressed air or steam, the former being supplied from three compressors which are installed in a basement chamber to reduce noise. Each of these supplies air to its own receiver at 150 psi and at a maximum rate of 84 cu ft of free air per min. The receivers can also be coupled together and one, two, or three compressors used as required.



The 47 ft long flame tunnel in operation, with the open hearth furnace model on right

Steam is supplied from a fully automatic oil-fired boiler of 1250 lb per hr capacity at 250 psi pressure. This is fitted with a superheater, capable of giving steam at up to 200° F superheat, which can be by-passed if saturated steam is required. Circulating water for cooling purposes is available at a rate of up to 6000 gal per hr, a closed circuit system with an air blast water cooler being installed in the adjacent courtyard.

Three combustion rigs have already been constructed:

1. *Flame tunnel.*—This is a cylindrical brick-lined tunnel, 47 ft long, with a 20 ft test section of 6 ft internal diameter. It will be highly instrumented and will be used primarily for flame evaluation, to answer such questions as the effect on heat transfer of changing from steam atomization of oil to air atomization and whether flame properties are influenced by atomization at the base or tip of the burner.

2. *Model open hearth furnace.*—This is a one-fifth scale model of a 100-ton cold charged furnace and will be used to test the effect of such variables as vertical burner angle. It is equipped with a calorimeter hearth and should enable the contribution to heat transfer by radiation and convection to be separated.

3. *Continuous pusher type reheating furnace.*—This is a one-fifth scale model of a pusher type furnace as used in bar mills. It will be fed automatically with 2 in. square billets which, after quenching, will return to the incoming end in order to maintain a continuous load. The furnace will be fully instrumented and will be used initially to evaluate the effect of certain principal variables, e.g. roof height and shape on heat transfer.

Although substantial, these initial rigs are not considered permanent and will in due course give way to others such as those required for the study of heat transfer in regenerator systems. A major question which it is hoped can be answered by the use of unconventional designs is the desirability or otherwise of recirculation in open hearth furnaces.

The activities of the laboratory will not be limited to combustion; in fact, the first tests made were in connexion with the development of certain specialized engineering equipment.

Universal Borer with Automatic Co-ordinate Setting and Depth Control

Jigs and setting-up involve high costs for the single or small quantity production but the problem can be met by automatic co-ordinate setting. Already successfully applied to the smaller horizontal borers, the BTH system has now been extended to control the three traverses of a large Kearns universal surfacing and boring machine

FOR several years H. W. Kearns and Company Limited, Broadheath, near Manchester, have been devoting their attention to the design of horizontal boring machines incorporating automatic co-ordinate positioning by electronic methods and their efforts were successfully demonstrated in 1956 by a No. O planer-table type horizontal boring machine fitted with British Thomson-Houston automatic co-ordinate setting equipment which they supplied to the British United Shoe Machinery Corporation.

This machine was the first commercial installation of its kind to incorporate this system and as fully described in our pages at the time* rapid two-co-ordinate setting to four places of decimals either from manual operated dials or from punched cards is automatically effected by servo-mechanism operating the horizontal and vertical slides of the machine. All together three machines of the plain travelling spindle type have been fitted with similar control equipment, and have now been in service for an aggregate operational time exceeding six years.

Following these successes H. W. Kearns and Company Limited in close co-operation with British Thomson-Houston Company Limited have developed a larger machine, a No. 3 patent universal horizontal surfacing, boring and milling machine and in addition to the two-dimensional co-ordinate setting have introduced automatic longitudinal positioning of the table saddle for controlling the depth of cut. The machine has been ordered by BTH for installation in their turbine factory at Rugby and is intended for single or batch production of components up to 5 ton in weight.

Machine design features for automatic control

The No. 3 machine, Fig. 1 has been specially designed to take full advantage of the accuracy in the order of 0·0001 in. which is available with electronic control. The 4 in. dia spindle, combined with a built-in facing chuck is capable of machining up to 42 in. dia, with a range of 24 speeds from 3·9 to 202 rpm. The top speed of the spindle range of 32 speeds is 700 rpm. The 4 × 9 ft main table has a cross traverse of 8 ft and carries 5 ft square revolving table which can be rotated very easily on a 36 in. ball track even when carrying an off-set load. This is achieved by a patented arrangement of four screw jacks, which operated simultaneously by a chain drive, raise the table clear of the main table. The longitudinal traverse of the main table is 5 ft and it is carried on a bed 8 ft 9 in. wide. Large rollers mounted on anti-friction bearings provide full support for the outer ends of the saddle. The servo-driven screw shaft for the cross traverse carries two worms and is mounted in P.T.F.E. lined bearings. The half nut which engages with the worms is built up in sections and extends the full length of table. One of the problems of introducing servo-controlled movements to this type of machine is overcoming the stick-slip characteristics set up by the combined weight of the tables moving over conventional slideways. It has been overcome by the use of roller assemblies resiliently-mounted in the lower surface of the table. Each assembly comprises a needle roller bearing with a hard synthetic rubber sleeve interposed between the outer race and the bore of the roller. With this patented arrangement the table movement is virtually a rolling motion and any resilience in the table after positioning is taken up by hydraulic clamping. The slideways have force-lubrication which automatically comes into operation when any traverse is set in motion and the connected oilways are cut at right angles to the slides in a "chicken ladder" pattern so as to produce a wedge shaped oil film between the surfaces.

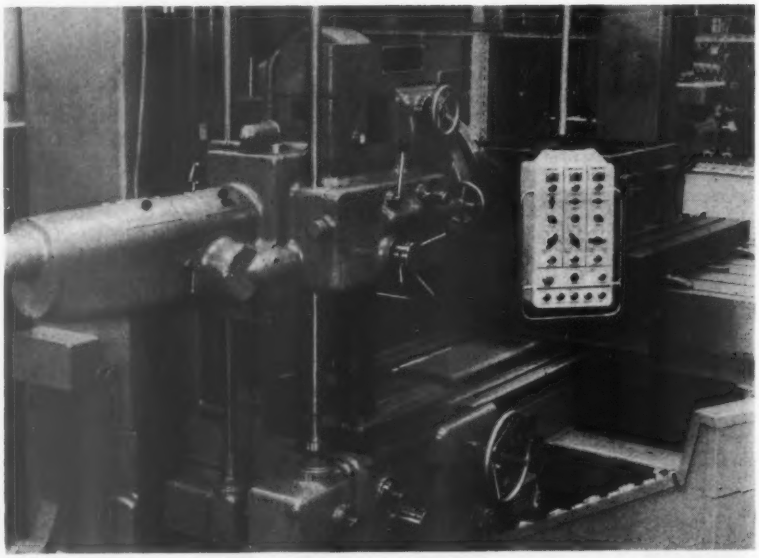


Fig. 1.—Close up of the spindle head of the No. 3 Kearns patent universal horizontal surfacing, boring and milling machine and to the right of the head the pendant control unit

Mechanical World, June, 1956. pp 274-277.

As previously mentioned hydraulic clamping is applied automatically to all slideways, the spindle head and the boring stay. The cylinder-actuated wedge clamping units grip through a friction lining on to steel rails attached to the main castings and are arranged so that their operation does not affect the setting. The vertical traverses of the spindle slide and boring stay bearing are synchronized mechanically. This alignment can be corrected when necessary by fine adjustment provided to the bearing which is fitted with a special optical unit.

The control system

The whole of the control for the electronic equipment for the machine is provided by the combined control desk and punched card reading unit, Fig. 2, and the pendant unit, Fig. 3. Co-ordinate settings for the vertical traverse of the spindle slide, and the transverse and longitudinal movements of the compound table can be made to any position either automatically by the punched cards or by hand operation of three separate rows of dials, one for each co-ordinate. Each row comprises six dials with clearly displayed figures appearing in aspects above each dial which indicate the required displacement in tens of inches, up to four places of decimals from any predetermined datum.

The card reader to be seen on the left-hand side of the desk, Fig. 2 takes standard size Hollerith cards which are fed through from a magazine. The punched hole instructions on the cards are previously prepared on a simple desk punch and are arranged in sequence to suit the settings to be carried out. Pressing the starter button for the reader causes each card which gives the settings for one co-ordinate to be individually read before being ejected into a collection hopper. An inspection window is provided to enable the operator to read the immediate card passing through. Interpretation of the instructions is instantaneous, the manual dials automatically turn to position and the co-ordinate digits are displayed in the aspects. The three meters mounted at the top of the desk indicate when coincidence has been reached between the machine tool slide positions and the setting displayed on the desk. These are used principally for setting the datum for measurement, but they also have the important function of cross checking positioning.

In addition to the controls on the desk, full operation of the electronic equipment is available to the operator from the pendant unit, Fig. 3. This carries five buttons for controlling the main driving motor for the spindle of the machine, another button which operates the automatic card reading unit on the control desk, and also the controls for each of the three motions, vertical, longitudinal and transverse.

The three upper rotary switches are used to select the setting sequence each being marked for "auto-position" (i.e. co-ordinate positioning by card), "manual" (i.e. manual positioning by dial), "auto-position feed" which serves to engage automatic reduced feed positioning and "clamp" position for hydraulic clamping after the setting is complete as indicated by green pilot lights at the top of the pendant.

For manual feed rates three rotary switches provide infinitely variable feeds from ½ to 10 in. per min. and below them three six-position rotary

Fig. 2 (above).—The combined control desk and punched card reading unit. The three rows of six dials may be used for hand setting each of the three co-ordinates to tens of inches and four places of decimals or alternatively the settings may be done automatically by punched card instructions passed through the reader unit on the left. For either method correct positioning is indicated by the meters at the top of the desk.

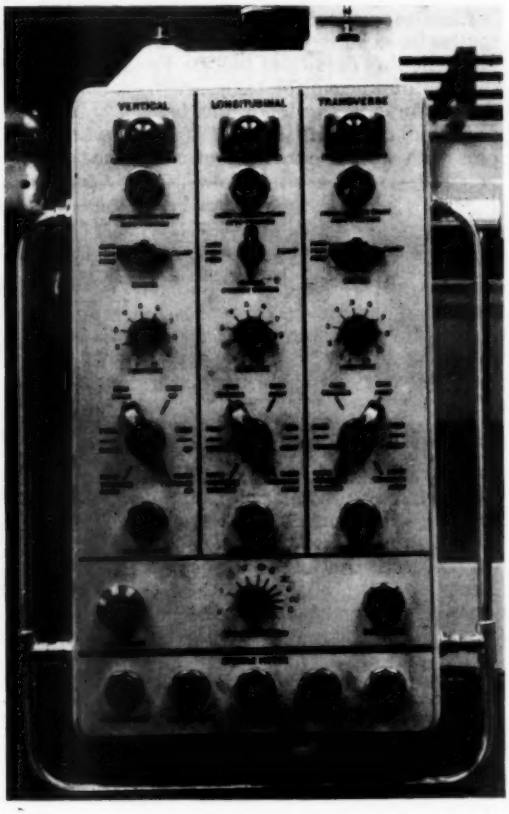


Fig. 3 (right).—The pendant unit for controlling the operation of the electronic equipment. Push buttons control the main spindle motor, the automatic card reader on the control desk and the traverse motions. Rotary switches are used to select setting sequence, slideway clamping and feed rates

switches control a rapid traverse of 120 in. per min, inching and feeds for all motions in either direction. When any traverse is set to "automatic feed position" the feed rate is automatically reduced to ¼ to 5 in. per min and this is controlled by the single rotary switch at the bottom of the pendant, a feature which enables all approaches to correct position to be made without overrun.

The measuring system

Identical servo-systems are applied to all three traverses and each is dependent on a rigid measuring bar scanned by an electro-magnetic sensing head to provide the control signals. Fig. 4 is a diagrammatic layout of the control system as applied to the main table; a similar system operates the vertical movement of the spindle slide and the longitudinal movement of the saddle. The measuring bars, Fig. 5 are of cast iron channel section in which a series of inch steel blocks or units are accurately spaced at 1 in. intervals. Each block contains a ¾ in. dia non-magnetic insert of brass and to ensure that the blocks have a pitch distance of exactly 1 in. each is made slightly less than 1 in. long to facilitate adjustment and clamping.

Final adjustment to the pitch centres is achieved by altering the magnetic flux density of blocks. For this purpose each block is cross-drilled on either side of the brass plug and two small stepped or D-pins with slotted heads are inserted in the holes. By slightly turning the D-pins the flux density can be altered and pitch corrections made to within 0·0002 in. Cast iron is selected for the measuring bar to match the machine table and avoid discrepancies due to unequal expansion. Thus the simple arrangement of building up the composite bar enables the whole measuring system to be set up at the maker's works, dismantled for dispatch to the customer and reassembled with the minimum of difficulty.

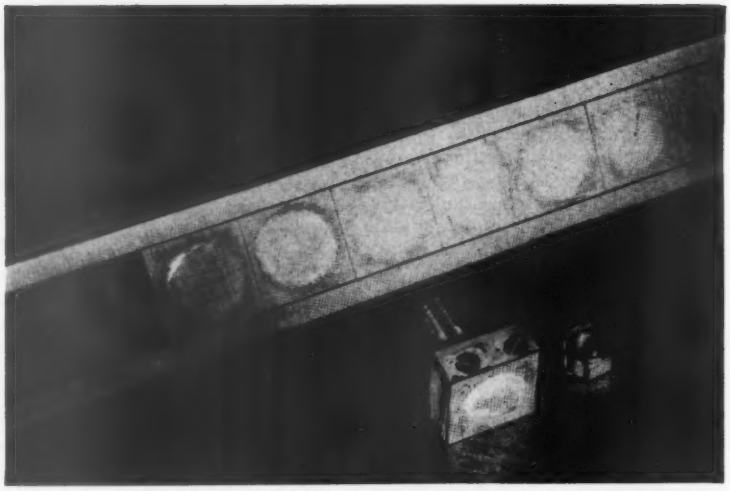


Fig. 5.—Measuring bar showing one of the 1 in. blocks removed. Each block has a ¾ dia brass insert and two holes cross drilled containing stepped or D-pins. Slight rotation of the pins alters the flux density of the blocks and enables pitch corrections to within 0·0002 in. to be made at the assembly stage

The electro-magnetic sensing head working in conjuction with the measuring blocks in the bar provides the electrical control signals. The head is mounted on a slide parallel to the bar and contains a pair of differential electro-magnets which respond to any misalignment from the magnetic centres of the reference blocks by sending signals of sufficient strength to the servo-motor to correct the error. The measuring bar thus provides accurate measurement of the integral inches and the decimal part is accommodated by further signals controlling a servo coupled to a gearbox-driven micrometer screw. Normally automatic approach to a desired position is made under rapid traverse of 120 in. per min to within 0·020 in. of the final position and the final approach is made at reduced velocity and under the control of the sensing head. This is caused by a temporary misalignment signal which is injected into amplifier B (Fig. 4) so that the table travels to a "false alignment" position approximately 0·020 in. from true position. The temporary signal is then automatically removed and thus the final approach to alignment is always made from the same direction.

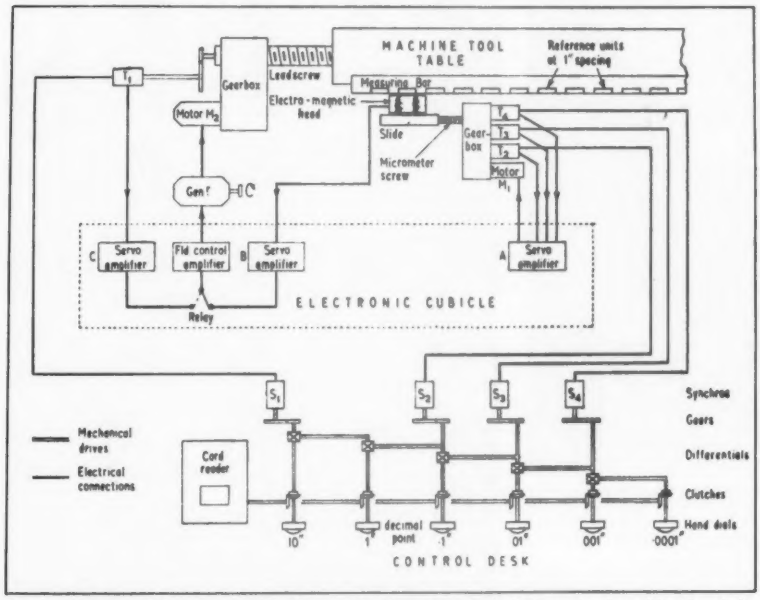


Fig. 4.—Diagrammatic layout of the control system for the main table. A similar system is used for the spindle vertical slide and longitudinal movement of the saddle

P.T.F.E. Insulated Wire

Two types of P.T.F.E. insulated wire for use at voltages up to 500 V r.m.s. and 1000 V r.m.s. in electrical instruments and equipment are now available from Siemens Edison Swan Limited, 155 Charing Cross Road, London WC2. The wire has either single or stranded annealed copper wires each silver plated to a radial thickness of not less than 0·00003 in.

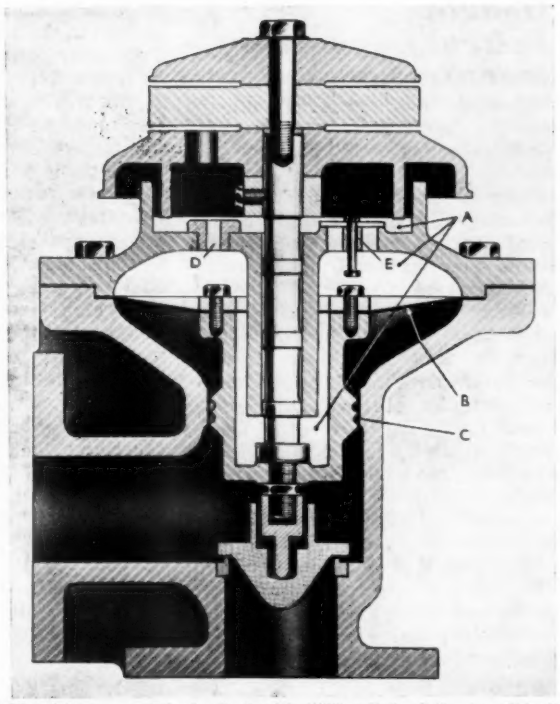
Liquid Oxygen Storage for the Small User

The LC 3 liquid oxygen cylinder has been developed by the British Oxygen Company Limited, Bridgewater House, Cleveland Row, St. James's SW1, to meet the oxygen requirements of the smaller customer, and its small size and large capacity, equivalent to 12 × 240 cu ft cylinders, means a considerable saving of space in customers' works, and economies in handling. The cylinder consists of a vacuum-insulated vessel containing liquid oxygen, and incorporates a vaporizing unit so that the oxygen is drawn off as gas. The cylinder, which will hold 2900 cu ft of oxygen, will supply gas at the rate of 300 cfh at a pressure of 85 psi. Its dimensions are 58 × 20 in. and it weighs 255 lb when empty.

The delivery lorry has a power-operated jib crane for unloading the cylinder on to the customer's wheeled trolley specifically designed for the purpose, for carriage to the manifold. One half of the manifold will be on supply to the pipeline and the other half standing in reserve. Gas from the cylinder is led through the manifold and a central isolating valve to a heater coil, after which the pressure regulator giving a maximum line pressure of 70 psi.

Dashpot Relief Valve for Corrosive Pressure Vessels

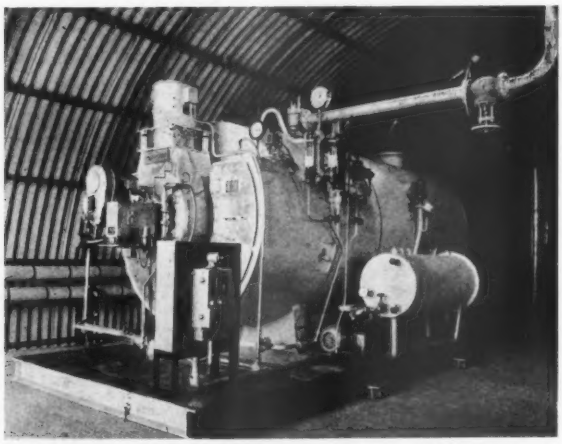
The generous oil sealing and cushioning of the valve spindle of the Butler dead weight pressure relief valve makes it ideally suitable for chemical process vessels in the low pressure range containing corrosives. Referring to Fig. 1 it will be seen that the sealing oil A entirely surrounds the long spindle guide and spindle and is retained by a flexible diaphragm B of P.T.F.E. or standard jointing material. The object of this immersion sealing is to prevent any possibility of corrosive vapours affecting the efficiency of the valve movement. In addition when the valve lifts the oil is rapidly displaced through the non-return valve E but the final return of the valve is cushioned by the oil which can only return through a small by-pass hole in the filler plug D.



Oil-sealed pressure relief valve developed by William Butler & Company (Bristol) Limited, for use with corrosive media at pressures up to 15 psi. A, sealing oil. B, flexible diaphragm. C, labyrinth seal to protect underside of diaphragm. D, oil filler and by-pass valve. E, non-return valve

A further feature is the fitting of a labyrinth seal C to retard the passage of hot vapour to the area below the diaphragm when the valve lifts and prevents overheating from the diaphragm.

The standard model is supplied with a cast iron body, with a variety of materials for the renewable seat and valve. They are produced in double-flanged patterns in 1, 2 and 3 in. sizes by Robert Harlow & Son Limited, Heaton Norris, Stockport, who are the sole manufacturers and selling agents.



PACKAGED TRIPLE-PASS BOILER.—The steaming capacities of Farrapac boilers built by Farrar Boilerworks Limited, Newark-on-Trent, Notts, range from 4,000 to 11,000 lb/hr, and if used as hot water units, outputs range from 4 to 11 million btu/hr. The burner is of the rotary-cup atomizing pattern and is capable of burning oils with viscosities up to 3,500 sec. Redwood No. 1 at 100°F. It is fully automatic and gives a variable or modulated flame over a wide range of steaming loads. The flue outlet connexion is at the rear and the smaller tubes are arranged and proportioned to maintain the thermal efficiency at approximately 80%. A full complement of controls is fitted including an overriding low water cut-out, which complies with latest requirements

Mini-tape Recorder Works off Batteries

A miniature tape recorder worked off batteries and weighing only 4½ lb has been introduced by Fi-Cord Limited, 40a Dover Street, London W1, for taking work-study notes, stock-checking, and compiling production reports.

The recorder measures 9⅝ in. long × 5 in. wide × 2⅝ in. deep, and records at standard speeds of 7½ and 1⅞ ips and has a hi-fi frequency response of 50 to 12,000 cps (± 3 dbs). The set is fully transistorized and an automatic charger is supplied to recharge each of the four 2V accumulator batteries from normal a.c. supplies. The set of batteries weighing 5 oz will provide 1½–3½ hr of recording without recharge depending on the speed and the recording time varies from 18 min per spool, 9 min each track at 7½ ips, to 72 min, 36 min on each track at 1⅞ ips.

There is a hi-fi output socket for linking the set to a hi-fi reproducer, and the microphone is carried in a pocket on the shoulder strap. The Fi-Cord which costs 59 gns records in any position and with the lid open or shut.

Hearing Instructions Above Intense Noise

Industrial noise is a continually growing problem and permanent physical damage to hearing and nervous systems can develop in situations where extreme noise is inherent with the operating conditions. Thus it becomes increasingly more important with the growing incidence of deafness amongst workers and the dangers of misunderstood instructions and warnings to have some form of ear protector and a means of communicating under otherwise impossible conditions. To this end Denis Ferranti Meters Limited, Llangefni, Anglesey, have developed and produced the most efficient and practical ear protector which should fulfil the requirements of industry.

The design of the Denis Ferranti Eargard provides for the absolute protection of the ears with a degree of comfort which permits wearing over very long periods, a factor which encourages their proper use. With the incorporation of transistorized equipment, either one or two-way communication is easily maintained however high the external sound level. The attenuators are in the form of plastic cups of D.M.C., an especially touch and noise resistant material produced for the Denis Ferranti Group by B.I.P. Chemicals Limited. Mounted on a spring steel wire head frame, the cups can be adjusted to the ears by means of four adjusting collets. A P.V.C. cushion partially filled with liquid makes an effective and comfortable seal between the wearer's head and the shells and as there is virtually no air contained in this cushion, it can safely be taken to high altitudes without bursting. Inside the shells is a foamed polyurethane attenuation sponge which may be removed and washed as required. A piece of foamed polyurethane is also mounted on the headframe and this forms a comfortable pad for the top of the head.

The cushioned earpieces and headframe of the Eargard are fully adjustable for maximum comfort

All the metal parts except the wire frame which is cadmium plated are of light alloy and are anodized.

The Eargards are also supplied equipped with transistorized induction loop receivers of compact design (without any appreciable increase in size) which allow the clear transmission of orders and, for two-way communication, can also be fitted with visor mounted noise cancelling microphones. Orders, instructions, warnings can be given from a control centre, remote from the source of noise, and this ease of communication speeds up reactions beyond any level obtainable from visual signals. A special feature of the Eargard fitted with an induction loop receiver is that it may be used with the normal telephone, the telephone hand set being held to the outside of the Eargard shell.

Top cover, adjustable buffer and base with the four, circular, interleaved, rubber-bonded-to-metal mountings, are the main components of the Cushyfoot 'S' mounting. The base of the adjustable buffer is rubber-covered so that there is no metal-to-metal contact under excess loads.

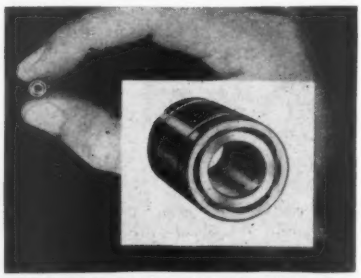
Anti-vibration Mounting for Locomotive Diesels

An engine anti-vibration mounting particularly suitable for diesel-electric and diesel-hydraulic locomotives has been designed by Metalastik Limited of Leicester. Measuring 4¼ in. in height when under load, the Cushyfoot 'S' as it is called has a vertical deflexion of 0·25 in. under a load of 2500 lb and provides for shunting shock loads up to 5g. An adjustable buffer restrains engine movement in all directions and as the adjustment for the buffer is at the top of the mounting, setting can be carried out within the engine compartment. On diesel-hydraulic locomotives where torque-reaction forces have to be considered in designing engine mountings, the vertical stiffness of the Cushyfoot 'S' is such that the buffer does not come into operation under these forces

From the illustration showing the main components of the mounting it will be apparent that the Cushyfoot 'S' gives different deflexions in transverse and fore-and-aft directions; under transverse loads the circular, rubber-bonded-to-metal springs are in shear while in a longitudinal direction they are in compression. In a vertical direction they are in shear and compression, giving both high-load capacity and large deflexions. The ratios of transverse, vertical and longitudinal stiffnesses are in the order of 1:3:17 and have been carefully selected to give the best results with maximum stiffness in a direction parallel with the crankshaft centre-line and the maximum flexibility is available transversely to cope with engine vibration.

Flake-resistant Silver Anodes

As a result of investigating the influence that different metallic structures and physical conditions have upon the performance of high-purity silver anodes in silver plating baths, Johnson, Matthey & Co. Limited 73-83 Hatton Garden, London EC1, have developed a new type of silver anode. By special processing Matthey C.A. anodes have a structure consisting of small equi-axed grains and are particularly resistant to flaking or shedding in high-speed plating baths. Moreover, the anodes show remarkable tolerance to variations in the composition of the electrolyte and in anode current density.



MINIATURE LINEAR BALL BUSHINGS—These new Ball Bushings, designated INST-258 and INST-396, are for use on shaft diameters of 0·1246 and 0·1871 in. Overall dimensions are: outside diameter 0·3125 in., length 0·5 in. and 0·375 in. and 0·562 in. respectively and they weigh only 0·15 and 0·30 oz. Despite small size, each bearing contains three complete ball circuits with each circuit containing 16 balls in the smaller and 17 in the larger Ball Bushing. Fabrication of precision ball circuits of this size was made possible by the development of special milling techniques, using a 16:1 pantograph ratio. The makers, Thompson Industries, Inc., Manhasset, New York recommend their use in place of ordinary friction type sleeve bearings for instruments, inertial devices and computors

Analysis of Pipe Structures for Flexibility. By John Gascoyne. London, 1959; Sir Isaac Pitman & Sons Limited. Wire bound, 45/- net (by post 46/-). 181 pp. 7 × 9¾ in.

The last twenty years have seen great changes in the approach to the design of piping systems, brought about by the number of installations where the piping is at high temperature and pressure. In such cases a careful stress analysis is absolutely necessary, but the same methods are usefully applicable to extensive piping systems where the duty is much less onerous but where, by reason of the long lengths of piping, even moderate changes of temperature cause considerable movement; or, if restraint is employed, considerable stress is set up in the pipe and considerable forces have to be absorbed in the anchorages. There are several methods of pipe stress calculation in use and the one employed by Mr. Gascoyne is the elastic centre, it being perhaps the most readily acceptable by engineers accustomed to the most widely understood ideas and methods of engineering design. The method is fully explained (perhaps we should add that a resumé is also given of other methods) and illustrated by worked examples. The latter are given in calculation sheet form and are a model of how to set out engineering calculations. The author is senior designer and stress consultant to a specialist United States concern. References in the text are to both British and U.S. standards.

Automation Today and Tomorrow. By L. Landon Goodman. London, 1959; Iota Services Limited. (Distributed by Newman Neame Limited). 40/- net (by post 41/-). 117 + 158 pp. 5½ × 8½ in.

The use of the automation principle may range all the way from the single machine to the automatic factory and may take in every kind of operation from the processing and assembly of discrete parts to the continuous operation of chemical plants and refineries. It is in effect the integration of a process with mechanical handling, servicing equipment and a control system. Just what great variety of automation has already been achieved is described in a most interesting way in this book, and yet, as the author also shows, only the fringe of the subject has been touched. Wherever quantity is required, or where it is desired to add quality to a mass produced product, or where complete control or accuracy are necessary, then automation can provide the means. There is a second part to the book (larger than the first part) in the form of a bibliography of the automatic factory, compiled by Iota Services Limited, and giving no less than 854 references, each with a brief description. The book is thus a practical reference work offering a competent technical survey of an unusual kind.

books

Mechanics: Part I, Statics. By J. L. Meriam. New York, 1959; John Wiley & Sons Inc. London; Chapman & Hall Limited. 40/- net (by post 41/6). 393 pp. 5¾ × 9 in.

However logical and scientific may be the rigorous, idealized treatment of mechanical problems, the method can only appeal to purely scientific minds. There are not enough of these to fill the great demand for engineers and technologists so there is ample reason for a practical approach to the teaching of mechanics to the great majority of students, using real problems which can be recognized by the student without any need for abstract visualization. Once Professor Meriam gets past the fundamental principles (and as he points out there are not many of these in mechanics) he uses this method of illustration, and his very first diagram is a real looking bracket recognisably bolted to the ground to which a wire rope with an eye splice is attached. This realism is continued throughout the book with all the principles and problems based on and illustrated by real machines or their elements. In this way he provides an introductory text to force systems, equilibrium, structures, distributed forces, friction, virtual work, vector methods, and moments of inertia.

Motor Manuals Vol III; The Mechanism of the Car. By Arthur W. Judge. London, 1959; Chapman & Hall Limited, 21/- net (by post 22/1). 542 pp. 4¾ × 7¼ in.

Since the last edition of this book there have been some notable innovations in car mechanism and in this sixth edition these are reviewed in a comprehensive 100-page chapter. Of particular interest are the modern transmission, suspension and braking systems. The rest of the book deals with the car in detail, from the chassis to the lubrication arrangements and taking in all the different mechanisms. The examples are drawn from popular and notable makes and the whole is instructive reading for motorist, mechanic or student. The other manuals in the series treat of engines, carburettors and fuel injection systems, and car maintenance and repair.

Packaging and Display Encyclopaedia. London, 1959; George Newnes Limited. 84/- net (by post 86/9). 705 pp. 8 × 10¾ in.

Packaging is an advanced subject nowadays; just how advanced can be appreciated from a perusal of this large and colourful volume. Essentially part of the production line, packaging employs much special machinery in a variety which can be appreciated from the illustrations in the book. This, however, is not its prime purpose: it is concerned with the package, how it is made and how it is applied, and that of course is something which interests every manufacturer for he wants the product to reach the customer in perfect condition and to the customer's entire satisfaction. Just how this is done is an art which uses a great range of materials in as many different ways. In addition to presenting technical information of this kind the book is a complete directory of sources of packaging materials and machinery.

Basic Mechanical Drawing. By Herbert E. Welch. New York, 1959; McGraw-Hill Book Company Inc. London; McGraw-Hill Publishing Company Limited. 41/- net (by post 42/9). 406 pp. 7¼ × 9¾ in.

This book offers complete tuition in mechanical drawing practice—not machine design or anything like that, but purely and simply drawing from the veriest beginnings to the final composition and execution. There seems to be nothing omitted so far as what one does with one's hands is concerned. In short, it tells exactly how to do it to the almost complete exclusion of what to do with the art when it is acquired. It is different from most books on drawing in this respect, yet the author makes good

use of his 400 or so pages. It should be a valuable book to the student, and more than valuable to the teacher because of the author's observation of the minutiæ of draughtsmanship.

Detecting Obstructions in Pipe-lines.—Safety precautions for workers who may be exposed to ionising radiations arising from the inclusion of radioactive markers in "Go-devil" devices for the detection of obstructions in pipe-lines are set out in a new booklet, "Radioactive markers in Go-devils; Safety Precautions", published by the Ministry of Labour and National Service (H.M.S.O., 1/- net). "Go-devils" consist of tightly fitted rubber washers, scraper vanes or wire brushes mounted on a central core. They are frequently used by oil, gas, water and other industries for detecting whether newly laid mains are free from obstruction, and also in the routine maintenance of existing pipe-lines. They are propelled through pipe-lines by means of water or compressed air, and they occasionally get jammed against an obstruction. Location of the cause can be an expensive procedure, involving excavations over a considerable length of pipe-line. The inclusion of a radioactive marker in the central core, which is exposed on contact with an obstruction, will overcome the difficulty because the gamma rays given off by the radioactive material can be readily traced above ground.

The use of radioactive substances in these devices requires the observance of strict precautions to avoid hazards which arise, and a Code of Practice for persons engaged in such operations is set out in this publication. This new illustrated booklet is one of a series dealing with safety, health and welfare in industry being prepared by the Ministry of Labour and National Service designed to give guidance and information about the best practices to be followed.

Expansion of World Production since 1938.—The Statistical Yearbook for 1958 published by the United Nations shows the remarkable expansion in world production that has occurred since 1938. The greater part of this is due to the output of manufactured goods which increased by almost 1½ times. The expansion in the volume of world activity was substantially greater in the heavy industries, that is those concerned with mineral processing, than in the light industries processing products of agriculture and forestry. Between 1948 and 1957 the volume of activity doubled in the manufacture of chemicals, petroleum and coal products, and almost reached the same level in the expansion of manufacturing of metal and non-metallic mineral products, while in the same period in the light industries the expansion was some 40%. The expansion in manufacturing suffered a setback in the fourth quarter of 1957 when North American output, contrary to the normal seasonal rise, was lower than that of the third quarter. As a result, world output remained stationary throughout the first three-quarters of 1958 and the volume of industrial output in this period was 4% below that of the first nine months of 1957, and only just reached the 1956 level.

In individual industries the greatest reductions in world output in 1958 as compared with 1957 were a 15% decrease in the basic metal products and a 6% reduction in the related activities of coal, metal and mining, and the metal products industries. The "Statistical Yearbook 1958", 612 pages, is available clothbound at 57/- net and paperbound at 46/- net from H.M. Stationery Office.

Electronic Animation.—A. H. Bruinsma, whose radio-controlled models have attracted attention at exhibitions all over the world, is the author of two new books published by the Philips Technical Library. They are "Practical Robot Circuits" (17/6d.) and "Multivibrator Circuits" (9/6d.). Both will be available in Great Britain and Eire from Cleaver-Hume Press Limited. "Practical Robot Circuits" deals with the basic principles of the subject, including a survey and description of the 'electronic sensory organs' of sight, hearing and touch. The function of the 'electronic brain' and the problems associated with robot construction are covered in other chapters. The author introduces his latest creation Cyber (pronounced Seeber) a plastic-coated dog, stuffed with mechanism that enables it to avoid obstacles in the dark, to approach a light, to bark and turn its head when offered food and to answer to its name. The reader is also given an insight into the working of the machine that plays noughts and crosses, crowing when it wins and groaning when it loses. The book is well illustrated with technical data and a number of folding diagrams. "Multivibrator Circuits" is a companion book to the above and describes devices extensively used in the construction and operation of robot models, but which also have many other uses.

New Standards

Power transformers (B.S. 171:1959). Price 20/-.

The revision of B.S. 171:1936 which also includes a revision of B.S. 422:1931, "Transformer inter-turn insulation", which is no longer available as a separate publication has been greatly extended in scope. It now applies to power transformers, reactors and earthing transformers having windings insulated with Class A, B, H, or C materials, with single-phase ratings of 1 kVA and above or polyphase ratings of 2 kVA and above. Both dry-type and oil-immersed type transformers are specified, temperature-rise limits are given, cooling methods, ratings, tappings and the marking of terminals are dealt with in considerable detail.

Full details of routine performance tests, impulse-voltage tests and the measurement of zero phase-sequence impedance are also included.

Preferred sizes of fireclay refractories (B.S. 3056:1959). Price 5/-.

Based on a proposed range of sizes submitted by the National Federation of Clay Industries, B.S. 3056 offers a selection which will meet most normal requirements encountered in furnace construction. The many tables in the 20-page publication are shown in association with keyed diagrams.

Enclosed distribution fuseboards for low and medium voltages (B.S. 214:1959). Price 5/-.

The scope of this revised publication has been confined to enclosed distribution fuseboards intended for use in systems in which the maximum current in each outgoing circuit does not exceed 200 amp and the declared voltage to earth does not exceed 250 V.

It deals with service conditions, ratings and types of fuseboards, marking, performance and construction.

British Standards Institution, 2 Park Street, London, W1.

BUSINESS & PROFESSIONAL

Personal

His Royal Highness the Duke of Edinburgh, K.G., K.T., G.B.E., has consented to become president of the College of Aeronautical and Automobile Engineering, Chelsea, from November 2, 1959, for a period of one year. **The Rt. Hon. The Lord Brabazon of Tara, P.C., G.B.E., M.C., Hon. F.R.Ae.S.,** is retiring, having been president of the college since 1950. The first president of the college, which was founded in 1924, was the late Lord Wakefield of Hythe. This year is the centenary of his birth.

THE GENERAL ELECTRIC COMPANY LIMITED announces the appointment of **Mr. C. S. Griffin, A.M.I.P.E.,** as manager of Coldair Limited, Wembley.

Mr. E. L. Ashley, manager of Northern Aluminium Company Limited Banbury Works for over quarter-of-a-century, has been appointed a director of the company. The board has accepted the resignation of **Mr. Kenneth Hall,** assistant director of operations of the parent company Aluminium Limited, Montreal, and a director of Northern Aluminium Company Limited since 1946.

Mr. L. Bailey has been appointed a director of United Steel Structural Company Limited, Scunthorpe, a subsidiary of The United Steel Companies Limited.

METROPOLITAN-VICKERS ELECTRICAL Company Limited announces the appointment of **Mr. P. T. Thornhill, B.Sc.Tech., A.M.I.E.E.,** as assistant chief engineer (contracts), switchgear department from March 1, 1959. The company also announce the retirement after forty-three years' service of **Miss Dorothy Smith, Assoc. M.C.T., M.I.E.E.,** on March 31, 1959. For most of this time an engineer in the motor engineering department, Miss Smith is well known in the electrical industry as one of the very few women to have achieved election (in 1958) to full membership of the Institution of Electrical Engineers. She was chairman of the Manchester branch of the Women's Engineering Society from 1943 to 1945 and continuously a member of the council since 1947. A new appointment in the company's personnel department is announced: as from March 1, 1959 **Mr. H. Walker, B.A., M.I.P.M.,** is appointed assistant manager, staff recruitment and training.

Mr. P. T. Appleby, purchasing agent for John Harper & Co. Limited, Albion Works, Willenhall, Staffs, has relinquished his duties after 50 years' service with the company. He will, however, continue in an advisory capacity. **Mr. E. McGill** has now taken over control of the purchasing department and **Mr. K. H. Westmancoat** has been appointed assistant buyer.

The Earl of Halsbury, F.R.I.C., F.Inst.P., who relinquished his position as managing director of the National Research Development Corporation at the end of March, is now a director of Sondes Place Research Institute.

THE following appointments in member firms of the Metal Industries Group are announced. Avo Limited.—Joining the board are **Sir Charles Westlake,** the chairman of Metal Industries, **Mr. John Black,** a director of Metal Industries, and **Mr. H. O. Houchen,** managing director of Brookhirst Igranic Limited. They replace **Mrs. E. Rawlings, Mrs. M. Brook** and **Mrs. I. E. Widdows,** who have resigned. Sir Charles becomes chairman of the board, with **Mr. J. H. Rawlings,** Avo's managing director, as deputy chairman. Towler Brothers (Patents) Limited.—**Mr. F. H. Towler** wishes to concentrate his attention on the technical development of new and improved hydraulic products and to facilitate this he is relinquishing his position as managing director of Towler Brothers (Patents) Limited, but will remain vice-chairman of the company. **Mr. E. Jones** will succeed him as managing director. Fawcett Preston & Company Limited, Bromborough.—**Mr. C. Smith** has been appointed contracts manager in the electrical division and **Mr. A. J. Taylor** as sales office manager.

SMART & BROWN (MACHINE TOOLS) Limited have appointed **Mr. Ian T. Jackman, A.M.Inst.B.E.,** as senior sales representative operating from 25 Manchester Square, London W1. Mr. Jackman was previously sales engineer for the Kerry Group.

BOWMAKER (PLANT) LIMITED have made the following appointments: **Mr. F. J. Butler** recently joined the sales staff and is in charge of the newly formed training school. For the past nine years, Mr. Butler has been in Nigeria where he worked for the United Africa Company Limited, Caterpillar dealers for that area. **Mr. V. L. Mullowney** recently joined the executive staff. At first he will co-ordinate building of the new depots at Cannock, Cardiff and Exeter.

Mr. Douglas L. Walker, C.B.E., formerly general secretary of the Federation of British Industries and who retired last week after 42 years' service, has joined the board of Triplex Holdings Limited, the parent company that controls the Triplex safety-glass and light engineering firms.

Mr. Neville Bertram has been appointed a director of Dunlop Rhodesia Limited. Mr. Bertram, who was born in Bechuanaland in 1909, joined the Southern Rhodesia civil service in 1926. Amongst the important positions he has held in recent years is the secretaryship for Commerce and Industry in the Central African Federation.

ENGLISH STEEL CORPORATION announces that **Mr. A. H. Hird, A.C.G.I., B.Sc., M.I.Mech.E.,** has been appointed to the board. Mr. Hird is also a director of Vickers Limited and a number of its subsidiary companies.

Mr. Peter J. A. Lubbock, M.I.A.M.A., formerly publicity manager of Dewhurst & Partner Limited, Hounslow, has recently joined Evershed & Vignoles Limited of Chiswick as advertising executive.

Mr. R. C. Stevens, A.C.W.A., has been appointed assistant sales manager of Clarkson (Engineers) Limited, of Nuneaton. Mr. Stevens recently returned from Canada where he was manager of Clarkson Engineering (Canada) Limited.

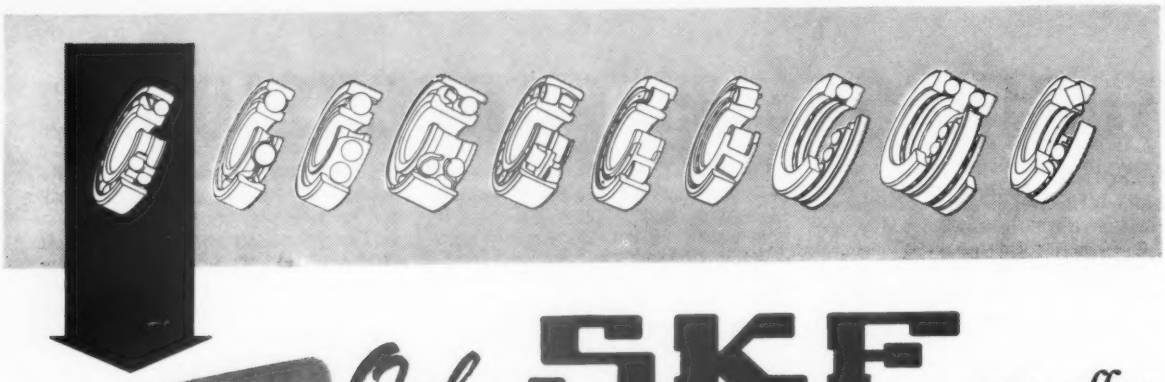
PRATT PRECISION HYDRAULICS LIMITED, a subsidiary of F. Pratt & Co. Limited, of Halifax, announce the appointment of **Dr. D. F. Denny** as chief technical executive responsible for design and development of the company's range of products. Dr. Denny joins Pratt Precision Hydraulics Limited after ten years as senior research engineer with the British Hydromechanics Research Association.

Mr. E. A. Skinner has been appointed general manager of Alfred Ellison Limited, Black Lake Ironworks, West Bromwich, where he succeeds **Mr. H. Hanks,** who has been elected to the board of directors. Mr. Skinner has been assistant general manager since 1955. Mr. Hanks has served the Ellison companies for 41 years.

Mr. W. J. Drake, after eight years with the Westinghouse Brake and Signal Company Limited, has joined Rijon Engineering Company Limited and Swindon Tool Company Limited, in the capacity of sales manager to both firms.

KEETON, SONS & CO. LIMITED, a member of the Firth Cleveland Group, announce the appointment of **Mr. C. W. Simpson, A.C.C.S.,** as company secretary and accountant.

Mr. G. R. T. Taylor has been elected the first president of International Combustion (Holdings) Limited. Mr. Taylor has served the company for over 35 years and was chairman until 1957.

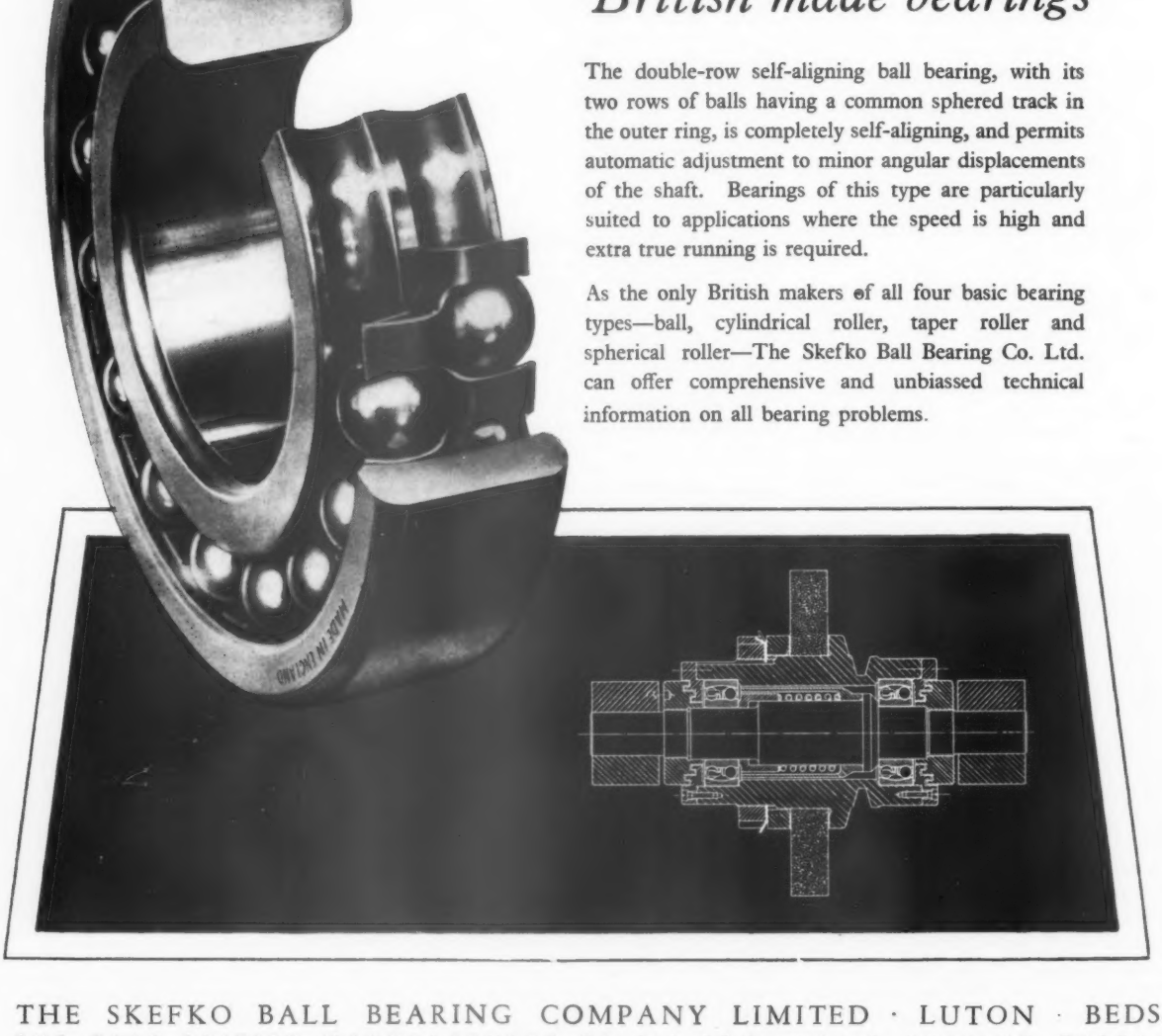


Only SKF *can offer*

such a wide selection of British made bearings

The double-row self-aligning ball bearing, with its two rows of balls having a common sphered track in the outer ring, is completely self-aligning, and permits automatic adjustment to minor angular displacements of the shaft. Bearings of this type are particularly suited to applications where the speed is high and extra true running is required.

As the only British makers of all four basic bearing types—ball, cylindrical roller, taper roller and spherical roller—The Skefko Ball Bearing Co. Ltd. can offer comprehensive and unbiassed technical information on all bearing problems.



THE SKEFKO BALL BEARING COMPANY LIMITED · LUTON · BEDS

THE ONLY BRITISH MANUFACTURER OF ALL FOUR BASIC BEARING TYPES: BALL, CYLINDRICAL ROLLER, TAPER ROLLER AND SPHERICAL ROLLER

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Mr. K. L. Coombs has been appointed divisional manager of Webb Conveyors and Automation Limited, of The Airport Works, Rochester, Kent, one of the companies in the Elliott-Automation Group. This company manufactures and sells the many different types of conveyor systems developed by Jervis B. Webb Company of Detroit.

WESTINGHOUSE BRAKE AND SIGNAL Company Limited announce that **Mr. George William Dunkley, O.B.E.,** was appointed a director of the company on March 25, 1959.

Mr. E. W. Pond after 54 years with Laurence, Scott & Electromotors Limited, of Norwich, interrupted only by service during the 1914–18 war, has how retired.

CHARLES CHURCHILL AND COMPANY announce the appointment of **Mr George S. Cutts** as sales manager. He was until recently the area sales manager of the London branch. This is a newly created post combining the sales of machine tools and engineers' supplies. A further new appointment is that of **Mr. W. Berridge** as group projects engineer. He was until recently the machine tools sales manager.

HAROLD HUBBARD LIMITED, 2 Aylsham Road, Norwich (Telephone No. 25941), have been appointed as technical representatives for Londex Limited for the counties of Norfolk and Suffolk.

Two new appointments are announced by Raleigh Industries: **Mr. D. P. Harris, M.A., M.Sc., A.M.I.Mech.E.,** was appointed technical director of the Raleigh organization from February. He will control all design divisions, laboratory (including process control) and product testing. Mr. Harris has also been appointed a director of Sturmey-Archer Gears Limited. **Mr. Leonard Shakesby** has been appointed in the capacity of chief production engineer.

Mr. Wilfred P. Fletcher, F.Inst.P., A.I.R.I., a recognized authority in the European rubber industry, has been named manager of the new Elastomers Research Laboratory, just completed by the Du Pont Company (United Kingdom) Limited at Hemel Hempstead, Hertfordshire.

Mr. G. S. Orr has been appointed manager of Mobil Oil Company's Scottish Division, with headquarters at Glasgow. He succeeds **Mr. A. Todd,** who is proceeding on leave of absence pending retirement.

Mr. Charles N. Thomson, chartered accountant, Dundee, has joined the board of Douglas Fraser & Sons Limited, Arbroath.

KAYSER, ELLISON & CO. LIMITED announce the appointment of the following local directors: **Mr. L. W. Hicks, A.M.(Sheffield), A.I.M.; Mr. E. D. J. Holloway; Mr. H. D. Button.**

Mr. W. Hackett, Jnr., and **Mr. R. D. Young, B.Sc.,** have been appointed assistant managing directors of Tube Investments Limited.

ATOMIC POWER CONSTRUCTIONS LIMITED, 28 Theobalds Road, London WC1 announce that as the first phase in the development of their research laboratories at Heston, Middlesex, have been completed, **Dr. R. J. Eldred, B.Sc.(Eng.), Wh.Sc., M.I.Mech.E., A.M.I.E.E.,** has returned to head office to continue his normal duties, and the permanent laboratory executives appointed at Heston are as follows: **Mr. H. E. Dixon, M.Sc., F.I.M.,** head of research and development; **Dr. A. G. H. Coombs, B.Sc., A.I.Mech.E.,** deputy head of laboratories. **Mr. D. C. F. Lunn, F.I.M.,** formerly deputy chief metallurgist, has been appointed chief metallurgist to fill the vacancy created by Mr. H. E. Dixon's appointment, and will be normally located at Head Office.

Obituary

WE regret to record the death on April 24, of **Mr. K. R. Hopkirk,** who until he retired last December, was director and chief mechanical engineer of the British Thomson-Houston Company.

WE regret to record the death of **Mr. G. A. Adams,** sales manager, engineering services division of Geo. Salter & Co. Limited, West Bromwich. Mr. Adams had been with the company for many years and was well known and respected throughout the engineering industry.

WE regret to record the death of **Sir Ashley S. Ward, LL.D.,** the well known Sheffield industrialist, at the age of 81, after a short illness in a London Hospital. Sir Ashley was president of Thos. W. Ward Limited, Albion Works, Sheffield, chairman of the Park Gate Iron & Steel Company Limited, Rotherham, vice-chairman of Laycock Engineering Company Limited, Sheffield and a local director of the National Provincial Bank Limited. He was a nephew of Thomas W. Ward, the founder.

Addresses

THE address of ACF (Great Britain) Limited, recently established as European representative and British licensee for ACF Industries, Incorporated, and its product divisions is at 55–57 High Holborn, London WC1.

THE Alloys Division of Union Carbide Limited has created a new Birmingham office, the address of which is 92 Newhall Street, Birmingham 3. Telephone number: Central 5011. Mr. Edward Pickard, Southern area representative, is already located at the new address.

Mr. E. WILSON, sales/service representative of Research and Control Instruments Limited for the whole area of Scotland has removed to the following address: 35 Hilton Road, Bishopbriggs, Nr. Glasgow. Telephone: Bishopbriggs 2320.

COX & WRIGHT (SHOE MACHINERY SERVICES) Limited, are now in their new factory at Wellingborough Road, Rushden. The telephone number, Rushden 3139 remains unchanged.

INTERNATIONAL COMPUTERS AND TABULATORS Limited (I.C.T.), 17 Park Lane, London W1, announce the formation of I.C.T. G.m.b.H., a subsidiary company with headquarters in Düsseldorf. I.C.T. G.m.b.H. will take over the existing business in Western Germany of Powers-Samas Accounting Machines (Sales) Limited, which has hitherto been conducted through a branch office in Düsseldorf. The formation of I.C.T. G.m.b.H. is a logical step in the planned development of I.C.T.'s world market. The eventual aim is to provide West Germany with equipment, servicing and training facilities equal to those already established by I.C.T. in the U.K. and in many other countries of the world.

BRITISH OIL EQUIPMENT CREDITS LIMITED, a subsidiary company of the Council of British Manufacturers of Petroleum Equipment, has been formed to promote schemes for the sale on deferred terms to overseas purchasers of capital plant and equipment made in the United Kingdom for the petroleum industry. The chairman of the company is Mr. E. F. E. Howard of Hayward Tyler & Co. Limited, the managing director is Mr. G. V. Sims, director of the council, and Miss D. B. Jaques is the company secretary. The address is that of the council at 2 Princes Row, Buckingham Palace Road, London SW1.

THE address of the London office of Hallmac Tools Limited, Wolverhampton, is now Suite 418, Cayzer House, 2–4 St. Mary Axe, London EC3. Telephone No. AVEnue 5792.

THE Birmingham service depot of Siemens Edison Swan Limited has moved from Henstead Street to new premises at 76–80 Sherlock Street, Birmingham 5. Telephone number Midland 0072. The Birmingham district office of Siemens Edison Swan Limited has a new telephone number, Midland 8391 (five lines).

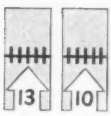
RANSOME AND MARLES BEARING COMPANY have moved their London office from Victoria Street to new and larger premises in Brixton Road. The new address is Cranmer House, 39 Brixton Road, London SW9, telephone RELiance 6771 and telex 25237.

Now

Woven-in Nylon *doubles* impact resistance

Twice as strong at the point of loading and twice as tear-resistant, Gaflex Nylon Weft Conveyor Belts are more resilient, more enduring than cotton—*weft yarns of nylon* increase weftway strength by 50% and warpway strength by 25%.

Increased Flexing Life
Nylon yarns are far tougher, yet more slender than cotton yarns. Gaflex Belts are thinner, more supple—*have 10 times more flexing life.*



Stronger Fastener Holding
The densely packed nylon wefted cross-section gives a firmer anchorage for fasteners —30% increase in strength with the *same* joint.

Better Troughing
Strong, supple nylon readily adopts the shape of the troughing idlers. Belts run more accurately, wander less and edge-wear is greatly reduced.

Gaflex Nylon Weft Belting is woven in weights which correspond broadly to the conventional duck weights of 28, 32, 36 and 42 oz. and will normally contain *one ply less.* Made in three types — Gaflex Standard, Super and Plus — each designed for specific grades of materials. There is a Gaflex Conveyor Belt to suit *your* particular conveying requirements.

GAFLEX
Nylon Wefted
CONVEYOR BELTING

The introduction of Gaflex Conveyor Belting adds a further achievement to a growing list of Angus Industrial Products of outstanding quality, amongst which are Maxgrip and Superangus Transmission Beltings, and all types of Suction and Delivery Hose.

Write for detailed literature to:—

GEORGE ANGUS & Co LTD

ANGUS HOUSE · NEWCASTLE UPON TYNE, 1

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THE Sheffield branch of Communication Systems Limited has moved into new premises at 27 Collegiate Crescent. Mr. J. L. Campbell is manager.

MR. WILLIAM K. GREGSON has been appointed area representative of Short & Mason Limited, Aneroid Works, 280 Wood Street, Walthamstow, London E17, and will operate from 32 Park Road, Sale, Cheshire.

A NEW sub-office of The English Electric Company was recently opened at 14 Albert Road, Middlesbrough (telephone Middlesbrough 44346/7). Mr. A. R. Johnson, B.Sc., A.M.I.Mech.E., A.M.I.E.E., A.M.I.Prod.E., is in charge.

HILL-BARNES (PUMPS) LIMITED is now known as Firth Cleveland Pumps Limited, a member of the Firth Cleveland Group. Mr. C. W. Hayward is chairman and joint managing director. Mr. R. W. Hill, managing director of the former company, remains as joint managing director. Mr. E. S. Mead, Mr. L. G. Oxford and Mr. S. H. Goss have also been appointed to the board. The company will operate from Field Head Works, Markfield, Leics. The London sales office will be established at Stornoway House, St. James's, SW1.

METAL CONTAINERS LIMITED, 17 Waterloo Place, Pall Mall, London SW1, have recently appointed Turner & Brown Limited, Davenport Works, Davenport Street, Bolton as their sole Northern agents covering Lancashire, Yorkshire and Scotland.

WELDCRAFT LIMITED, who recently became part of the G.D. Peters group of companies, have moved to Windsor Works, Slough, Bucks. The new telephone number is Slough 23201.

THE telephone number of British Insulated Callender's Cables Limited, Bournemouth depot has been altered to Bournemouth 36223.

DELAPENA & SON LIMITED, manufacturers of induction heating and honing equipment, have now moved the major part of their administrative staff to new offices in Cheltenham. The address is Tewkesbury Road, Cheltenham, Glos., and the phone number Cheltenham 56341 (Telex 43354). The factory remains at Zona Works on the present site, along with drawing offices, works management and advertising departments.

THE FIRTH CLEVELAND GROUP has opened an office in Toronto. The address is: Firth Cleveland Limited (Canadian Office), 94 Laird Drive, Toronto 17, Canada. Telephone: Hudson 3-2775.

NATIONAL ENGINEERING LABORATORY is the new name of the D.S.I.R. Mechanical Engineering Research Laboratory (MERL) at East Kilbride, Glasgow.

Business Developments

Company acquisitions

THE SIMMS MOTOR & ELECTRONICS CORPORATION Limited have acquired the whole of the issued share capital of Aircraft Steel Structures Limited.

THE SHEFFIELD WIRE ROPE COMPANY Limited of Darnall, Sheffield, has been acquired by the Firth Cleveland Group of Companies.

THE DAVID BROWN CORPORATION LIMITED is to affiliate with Foote Bros. Gear and Machine Corporation of Chicago, and will acquire a substantial minority interest in Foote Bros.

JOHNSON, MATTHEY & CO. LIMITED have acquired an interest in the Italian precious metal refining and manufacturing company—Metalli Preziosi S.p.A. of Milan.

THE British and American shares of British MonoRail Limited (Wakefield Road, Brighouse, Yorks.) have been acquired by Herbert Morris Limited, Loughborough.

METAL INDUSTRIES LIMITED have acquired the shares of AVO Limited.

Agents and distributors

UNITED Kingdom and Northern Ireland agents for the mining equipment and compressors of Demag, Duisburg, Western Germany, are William H. Capper & Company Limited, Mayfair House, 8-9 Hertford Street, London W1. Messrs. Capper will undertake installation and service and are equipped to design, fabricate and instal associated pipework.

AGREEMENT has been reached between Short Brothers and Harland Limited, Belfast, and Conveyancer Fork Trucks Limited, Warrington, whereby the latter company will be the sole distributors at home and overseas of straddle carriers manufactured by Shorts in Northern Ireland. Hitherto known as British Straddle Carriers, the vehicles will in future be known as the "Shorland" range of carriers.

PRITCHETT & GOLD and E.P.S. Company Limited, Dagenite Works, Dagenham Dock, Essex, have taken over the trading activities of The Alton Battery Company Limited.

ELLIOTT BROTHERS (LONDON) LIMITED, subsidiary of Elliott-Automation Limited, has secured from Canadian Curtiss-Wright Limited exclusive rights to make and sell nucleonic thickness measuring apparatus developed by the Canadian concern.

BALDWIN INSTRUMENT COMPANY LIMITED, Dartford, Kent, announces the appointment of the following agents and technical representatives. Scotland—James Scott & Co. Limited, 68 Brockville Street, Carntyne Industrial Estate, Glasgow E2. Tel.: Shettleston 4206-9. North of England—Wm. Don & Partners Limited, Crown Works, Crown Point Bridge, Leeds 9. Tel.: Leeds 33781-2. Mr. J. D. Thornley, Waterhey Cottage, Rivington, Nr. Bolton, Lancs. Tel.: Horwich 364. Midlands—Mr. P. Lawrence, 16 Hawthorn Road, Kings Norton, Birmingham 30. Tel.: Kings Norton 4476.

Trading agreements

THE PYRENE COMPANY LIMITED has formed a new wholly owned subsidiary company "Pyrene-Panorama Limited", to take over as a going concern from Panorama Equipment Limited, Panorama Equipment (Export) Limited, and Industrial Protection Limited, manufacturers of safety glasses, goggles, helmets and other safety equipment. Mr. Francis A. J. Harrison, chairman and managing director of The Pyrene Company Limited, is to be chairman of the board of the new company.

PERKINS ENGINES LIMITED, a new subsidiary of F. Perkins Limited, formed to handle sales and servicing of Perkins vehicle, agricultural, marine and industrial engines throughout the world, will be located at Peterscourt, Peterborough, former headquarters of F. Perkins Limited's marketing divisions, and will be entirely separated from the main production centre at the Eastfield plant. The managing director of the new company is Mr. T. H. R. Perkins, who is also a director of F. Perkins Limited, and other directors of the subsidiary are Mr. M. I. Prichard, managing director of F. Perkins Limited, and Mr. W. N. Collins, a director of the parent company.

BY agreement with Knapp Mills Inc. of New York, U.S.A., the exclusive manufacturing rights in Britain of a patent form of radiation shielding are held by David Brown Industries Limited. Manufacture of the shielding will be carried out at the David Brown Jackson Division, Salford, Lancs.

INTERNATIONAL PLASTICS LIMITED have reached agreement with Baehre Metallwerk, K.G., Springe, Hanover, for the exchange of technical information and the rights of sale of small particle board plants under the name Bartrev-Bison, in the U.K. and overseas.

AGREEMENT has been reached between the Incandescent Heat Company Limited, Smethwick, and Swenson Evaporator Co. (a division of the Whiting Corporation) of Harvey, Illinois, by which Incandescent have exclusive selling and manufacturing rights in the U.K. for all Swenson products. Incandescent Heat Co. have for some years manufactured process equipment to Swenson designs.

Eclipse

for the tough jobs

Every day at the "Eclipse" Works a battery of no less than 21 hacksaw machines of different types is constantly at work to make sure that, under practical workshop conditions, "Eclipse" hacksaw blades stand up to the most arduous tasks imposed by new materials and new production methods. This is just one of the reasons why "Eclipse" hacksaw blades give you the best value and utmost reliability.

Eclipse hacksaw blades & other tools are made by James Neill & Co (Sheffield) Ltd, and are obtainable from all tool distributors

UH 32

THE automobile gasket division of Hall & Hall Limited, Oldfield Works, Hampton, Middx. has been sold to the Engineering Components group of Companies. Industrial gasket production will be continued and developed, and the trade mark "Hallite" remains the exclusive property of Hall & Hall Limited.

Contracts and Work in Progress

HOPKINSONS LIMITED, Huddersfield.—Supply of large butterfly control valves for Latina nuclear power station.

R. F. LANDON & PARTNERS LIMITED (subsidiary of Simms Motor & Electronics Corporation).—Supply of heavy oil burners for installation in the I.T.V. building in Norwich, and burners to operate on d.c. for boilers in two new Liverpool ferry boats.

BRITISH INSULATED CALLENDER'S CABLES Limited.—Contract value approximately £¼M. for the supply and installation of telephone cables on the Crewe–Manchester route of British Railways.

Specially manufactured conductors for the 11¾ mile link across the Bosporus of the 154 kV transmission line from East to West Turkey.

HEENAN & FROUDE LIMITED.—All equipment for the heat engine laboratories of Plymouth Technical College.

Supply of special motoring/absorbing dynamometer to the Institute Nacion a de Technia Aeronautica, of Madrid.

GENERAL ELECTRIC COMPANY LIMITED.—Order value around £20M. for the construction of a 150 MW atomic power station for Japan.

Other large engineering orders include one for two 200 MW turbo-generator sets for the Kincardine station of the South of Scotland Electricity Board valued at about £4M. and one for a complete ore preparation plant for the Redbourn Works of Richard Thomas and Baldwin Limited, valued at about £1¼M.

THE POWER-GAS CORPORATION LIMITED.—Order worth £A800,000 for one unit of carburetted water gas plant for the Australian Gas Light Company, Sydney, awarded to the Australian subsidiary, The Power-Gas Corporation (Australasia) Pty. Limited.

PYE TELECOMMUNICATIONS LIMITED.—Contract from Iranian Oil Operating Companies for radio communication system between Kharg Island in the Persian Gulf, the oilfield at Gachsaran and the Agha Jari oilfield.

Contract from Government of Belgian Congo for installation of Pye Instrument Landing System valued at £60,000, at both Elisabethville and Leopoldville airports. This system has also been installed at Geneva International Airport, Prague and Moscow airports. The Indian Air Force are at present installing their first Pye I.L.S. system.

GRESHAM TRANSFORMERS LIMITED.—Order for £20,000 of Public Electricity Supply Transformers from the Electricity Department of the City Council of Singapore.

CDC CONTROL SERVICES, INC. Pennsylvania.—Contract to supply Rolls-Royce Limited, Derby, with anti-surge control equipment for some of the motor driven air compressors in the Rolls-Royce high altitude engine test facility. Consulting engineers are McLelland and Partners, London.

THE BRITISH THOMSON-HOUSTON COMPANY Limited.—Order from British Transport Commission for further contract for 37 B.R. type 2 diesel-electric locomotive equipments.

EKCO ELECTRONICS LIMITED.—Supply of Ekco Type E160 airborne search radar equipment with Doppler drift measurement facilities for the Middle East Airlines entire fleet of Vickers Viscount aircraft. Order valued at £½M.

E.M.I. ELECTRONICS LIMITED.—Contract to supply telecine equipment for new commercial television station at Brisbane, Australia.

Order for general-purpose analogue computer, Emiac II, for Australian Government Aircraft Factory, Melbourne.

METALECTRIC FURNACES LIMITED, Smethwick. (Subsidiary of Incandescent Heat Company Limited).—Order for a continuous malleablizing plant at Gloucester Foundry Limited.

SIEMENS EDISON SWAN LIMITED.—Orders totalling £¾M. for the supply and installation of cables on the Southern Region electrification of British Railways.

ENGLISH STEEL SPRING CORPORATION Limited.—Two replacement orders worth £24,100 for railway coil and laminated springs for delivery to Portuguese East Africa, passed through Monteiro Gomes, Ltda., Rua Cascais, 47 (Alcantara), Lisbon.

FAWCETT PRESTON & COMPANY, Bromborough, Ches. (Subsidiary of Metal Industries Limited).—Orders for three thermoplastic extruders for shipment to Italy and the Argentine. Value approximately £23,000.

BROOKHIRST IGRANIC LIMITED. (Metal Industries Group).—Order value £12,000 for four magazine conveyors from Amalgamated Press.

GEORGE WIMPEY & Co. LIMITED.—C.E.G.B. contract worth nearly £200,000 for complete coal handling plant at Richborough Power Station, Kent.

TUBE INVESTMENTS LIMITED.—£2M. contract with Promsyrioimport for export to Russia of stainless and alloy steel tube.

G. &. J. WEIR LIMITED.—Order from Government of Kuwait for world's largest sea water distillation plant.

SAVAGE & PARSONS LIMITED, Watford.—Contract worth approximately £15,000 for 12 Master Slave manipulators for remote handling of radio-active materials for Atkiebolaget Atomenergi, Sweden.

TAYLOR WOODROW (NIGERIA) LIMITED.—Contract worth approximately £300,000 for oil pipeline in Eastern Nigeria, placed by Shell International Petroleum Company Limited.

TAYLOR WOODROW CONSTRUCTION LIMITED.—A £1M. contract from the British Transport Commission (Southern Region) for the design and construction of a Continental perishable goods traffic building.

TAYLOR WOODROW (Building Exports) Limited, Contracts worth nearly £100,000 have been awarded to a London firm by American contractors for the National Iranian Oil Company. A series of Arcon steel-framed prefabricated buildings is being supplied by Taylor Woodrow.

MOLINS MACHINE COMPANY LIMITED, London.—Order worth £3M. for 280 cigarette making machines of new design.

REDLER CONVEYORS LIMITED, Stroud, Glos.—Order placed by Simon Handling Engineers Limited, a member of the Rustyfa Consortium of British firms who are equipping a tyre factory in U.S.S.R. for Redler mechanical conveying equipment.

DAVID BROWN CONSTRUCTION EQUIPMENT Limited, of Feltham, Midx.—Equipment value £125,000 ordered over recent weeks.

Cranfield Work Study Course

A SYLLABUS of subjects has been arranged to form a new course in work study and planned maintenance directed particularly to maintenance engineers. The three-week course, which involves residence, will be held from June 8–26 and the inclusive fee is £90. Enquiries should be addressed to the director of studies at the Work Study School, Cranfield, Bletchley, Bucks.

Materials Handling

THE NATIONAL JOINT COMMITTEE ON Materials Handling is willing to assist secretaries of interested societies and other bodies drawing up their programmes for the 1959/60 session by suggesting suitable subjects for lectures and possible lecturers. Further information may be obtained from the secretary of the committee at 69 Cannon Street, London EC4.

"Steel-Shaw" Exhibition June 9—13

"STEEL-SHAW" high speed ball mills, mark I and V, the "Steel-Shaw" Kady kinetic dispersion mill and the "Quickway" paint conditioner will be displayed at the Steel & Cowlishaw Limited special exhibition at the Birmingham Exchange and Engineering Centre, Stephenson Place. It will be open all day until 9 p.m. and on the Saturday morning, June 13.

Trade Literature

Coventry Diehead Instruction Chart

For the benefit of users' of Coventry dieheads, particularly engineering apprentices and students Alfred Herbert Limited have issued an instructional chart (40 × 30 in.) for the Diehead. Copies are available, price 15s. per copy, and orders should be sent to the Technical Education Department of Alfred Herbert Limited, Coventry.

Welded Tube Stock List

An interesting booklet illustrating the manufacture of bright and semi-bright welded steel tubing has been issued by Helliwells Limited, Robertstown, Aberdare, Glam. Stock sizes listed range from $\frac{3}{8}$ to 2 in. bore.

Quenching Oil Coolers

Rapid dissipation of the heat absorbed by quenching oils is one of the problems of efficient heat treatment. The Visco Sprayblast cooler was the first oil cooler to use a mixture of air and water as the cooling medium instead of either air only or water only, and it incorporates the advantages of both without their disadvantages.

Full details are contained in a brochure No. 591 issued by The Visco Engineering Company Limited, Stafford Road, Croydon.

Reduction Gears, Slipping Clutches and Magnetic Clutches and Brakes

A new series of publications covering a wide range of transmission equipment is now available from Crofts (Engineers) Limited, Bradford 3, Yorks. Publication 5914 deals with universal mounting worm geared motors which are available from stock in four sizes; $1\frac{1}{8}$, $1\frac{3}{4}$, $2\frac{1}{4}$ and 3 in. centres covering power ranges from fractional to 4.5 hp at ratios from 5:1 to 60:1. Publication 5916 describes the Croft-Ring flexible couplings for powers up to 80,000 hp at 100 rpm. Multi-speed geared motor units and reduction gears from fractional up to 1 hp are covered in Publication 5921. To protect all types of machinery from shock and overload the Crofts emergency slipping devices detailed in Publication 5922 are available from fractional up to 105 hp at 100 rpm. Typical applications of Crofts stationary field magnetic clutches are shown in Publication 5923 together with data to assist in correct selections.

Two- and Three-way Poppet Valves

Further additions to the range of equipment manufactured by Lang Pneumatic Limited, Victory Works, Birmingham Road, Wolverhampton are shown in leaflets. The items include $\frac{1}{4}$ in. B.S.P. two- and three-way air operated poppet valves, $\frac{1}{4}$ in. B.S.P. two- and three-way solenoid operated poppet valves, and an air gun of 20 cfn air flow capacity.

Hoists and Overhead Cranes

A brochure illustrating the many varied types of Clayton overhead crane in service in factories and workshops at home and abroad has been produced by The Clayton Crane & Hoist Company Limited, Irwell Chambers East, Union Street, Liverpool 3. Types shown include travelling cranes, low headroom cranes, light hand cranes and wall cranes, and of varying capacities, depending on type, up to 10 ton.

Metal Sinterings for Industry

A comprehensive guide to the possibilities and economies achieved by the use of metal sinterings in industry has been produced by The British Metal Sinterings Association. The brochure covers all aspects of the process, design considerations, tolerances, tool making and the choice of lubricants. Numerous examples are shown together with the cost saving figures for comparison with conventional methods of manufacture. Copies are obtainable by application to the association secretaries, Peat, Marwick Mitchell & Company, Beaufort House, Newall Street, Birmingham 3.

Lubrication by Grease

The choice of lubrication of any particular unit or machine—grease or oil and if a grease, which type to use and why—these are some of the questions answered in an illustrated technical publication of the above title which has been compiled by Germ Lubricants Limited, Bloom Street, Salford. Other sections deal with grease characteristics and tests and the application of special purpose greases.

Cold Galvanizing

The Rust-Anode cold-galvanizing process is the subject of a leaflet published by C. & P. Development Company (London) Limited, Wiggie Works, Redhill, Surrey. Rust-Anode is a metal coating which can be applied to steel surfaces by brushing, spraying or dipping to leave a coating of pure zinc—strongly adherent and ensuring cathodic protection.

Electro-mechanical Brakes

Illustrated examples of electro-mechanical disc brakes applied to a.c. and d.c. motor drives for machine tools, hoists, conveyors and textile machinery are given in List ML.87 from Lancashire Dynamo & Crypto Limited, St. Stephen's House, Victoria Embankment, Westminster SW1.

Swarf and Scrap Handling Conveyors

The problem of handling swarf, from the discharge from the machine, through the conveyor system and transfer points to the crushing and oil recovery sections or to the baler is thoroughly investigated in the pages of a brochure issued by the New Conveyor Company Limited, Brook Street, Smethwick, Birmingham 40.

Horizontal and High Discharge Type Truck Mixers

Abridged specifications of the Rapier horizontal drum truck mixers and high discharge truck mixers are contained in leaflets 4/431 and 1/523 issued by Ransomes & Rapier Limited, Ipswich.

New Factories

Barnard Castle. J. J. Robinson and Son, poultry appliance manufacturers. The architect for new factory is J. Lawton, Park Terrace, Barnard Castle.

Bishop Auckland. Atcost Limited, Tunbridge Wells, have decided on a site at St. Helens, Bishop Auckland, for the erection of a new factory for making precast concrete buildings. The factory will be built by direct labour, and when completed is expected to employ 200 men.

Carlisle. West Cumberland Farmers, Limited. The architects for an egg canning station at Harraby Green are Graham and Roy, 6 Paternoster Row, Carlisle.

Tyre Services (Carlisle) Limited. The architect for office additions on Durranhill industrial estate is N. M. Phillips, 43 Oxford Street, Workington.

Consett. Celluware Limited propose factory additions to plans by Fennell and Baddiley, Bridge End Chambers, Chester-le-Street.

Cumberland. The West Cumberland Industrial Development Company Limited, 30 Roper Street, Whitehaven, are considering extensions to two factories in West Cumberland, and applications are being received from other tenants of the company's factories for additions to be made. The concern's architects are Ward and Partners, 29 Chesham Place, Belgrave Square, London, SW1.

Darlington. East Haven Hospital. The Town Council has accepted the tender of the Norris Warming Company, Newcastle upon Tyne at £3160 for installation of boiler plant.

Durham. Holmes and Jones, Poplar Building, Washington, have submitted outline proposals to the planning authorities for industrial development at Woodbine Farm, Pity Me, Framwellgate Moor.

Gateshead. North-Eastern Trading Estates, Limited, Team Valley Trading Estates, Gateshead have announced that 15 more factory extension schemes are proposed in the North-East.

Hebburn-on-Tyne. A. Reyrolle and Company Limited. New office block of 95,000 sq ft. Work has begun on the foundations by Sir R. McAlpine & Sons, Jesmond Road, Newcastle upon Tyne.

Jarrow. Charles Lennig (Great Britain) Limited, propose main office block of 75,000 sq ft at their Jarrow works.

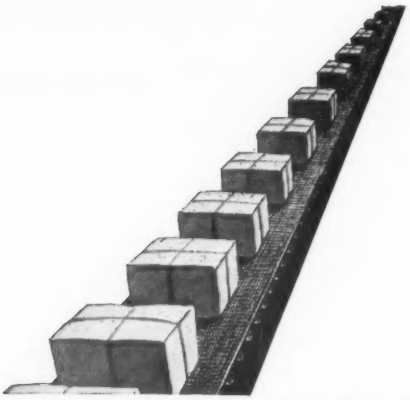
Newcastle upon Tyne. C. A. Parsons and Company Limited. Plans have been approved for extending the heavy erecting shop.

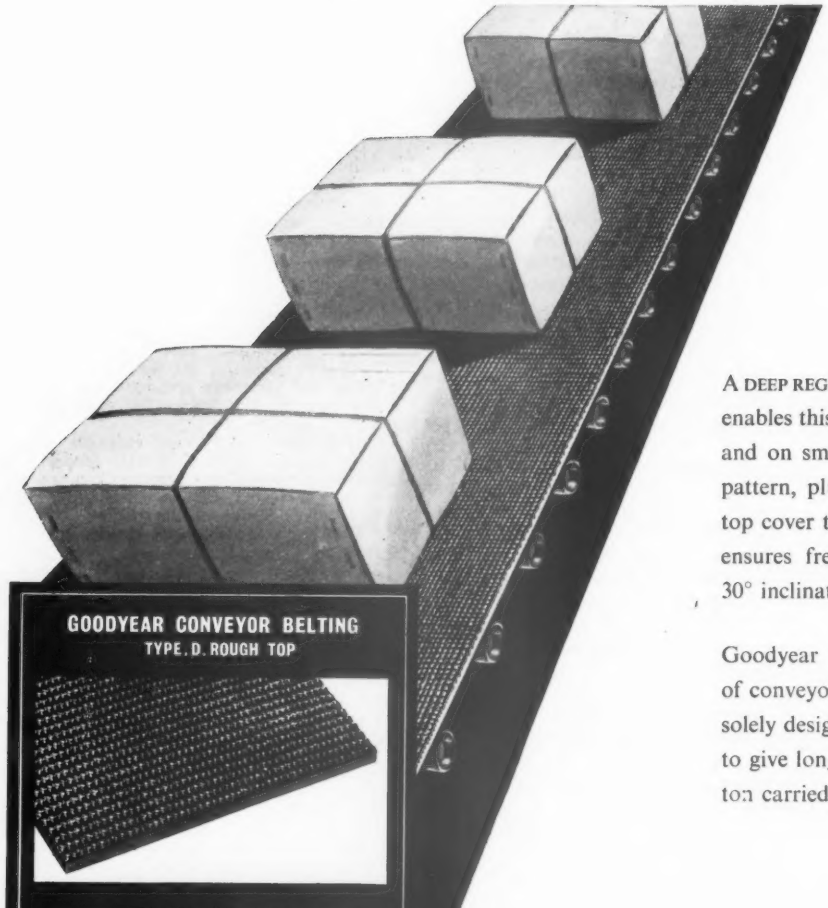
Adams and Gibbon Limited, St. Thomas Street, Newcastle upon Tyne are to proceed with another phase of their scheme for a multi-storey garage in Westmorland Road and Lord Street. The architects are Wetherell, Lamb and Partners, 24 Picton Place.

Continued on page 288

LIFT WITHOUT SLIP

with Goodyear rough top conveyor belting





GOODYEAR CONVEYOR BELTING
TYPE D. ROUGH TOP

A. Thick top cover with deeply impressed gripping pattern.

B. Carcass of 28 or 32 oz. high quality cotton duck.

C. Thickness of hard wearing bottom cover or friction surface to suit service.

A DEEP REGULAR pattern, exclusive to Goodyear, enables this belting to take a firm grip on sacks and on smooth articles, such as cartons. The pattern, plus a choice between soft and hard top cover to suit the needs of the installation, ensures freedom from slip on slopes up to 30° inclination.

Goodyear Rough Top belting, like all styles of conveyor belting in the Goodyear range, is solely designed for a specific type of duty, and to give long, reliable service at lowest cost per ton carried.

GOODYEAR

INDUSTRIAL RUBBER PRODUCTS

CONVEYOR BELTING • TRANSMISSION BELTING • HOSE • V-BELTS

Continued from page 287

Strakers (Newcastle) Limited. Plans by the Brydon Construction Company Limited Glasgow, W5 for the erection of a multi-storey garage in Vincent Street have been approved.

H. C. Troldahl, Limited, Scotswood Road. The architect for alterations and additions is E. M. Lawson, Barras Buildings, Barras Bridge.

Limmer and Trinidad Lake Asphalt Company Limited. Office additions are proposed in Glasshouse Street to plans by C. S. Errington, 46 Grainger Street, Newcastle.

North Shields. Hodges-Brown and Company Limited, engineers etc, 25 Trafalgar Street, Newcastle upon Tyne, are to erect machine and fabricating shop, offices, and storage accommodation on a 6½ acres site in Wallsend Road, Percy Main. The firm have prepared their own plans.

Shildon. Morris Furnishings Limited. The tender of C.T.C. (Builders), Limited, Blackhill, has been accepted for factory additions. The architects are Cackett, Burns Dick and MacKellar, 21, Ellison Place, Newcastle upon Tyne.

Sunderland. Short Brothers, Pallion Shipyard. To build a temporary plate preparation shop. The builders are Brims and Company Limited, Pandon Buildings, City Road, Newcastle upon Tyne.

Whickham (Co. Durham). C.A.S. (Industrial Developments) Limited, Kensington Square, London. Plans are being prepared by Llewelyn Smith and Waters, 103 Old Brompton Road, London, SW1 for the erection of an office block at Swalwell.

Whitehaven. Smith Brothers (Whitehaven) Limited. Tenders are to be considered by West Cumberland Industrial Development Company Limited, 30 Roper Street, Whitehaven for additions (11,000 sq ft) to factory at Hensingham. The architects are Ward and Partners, 29 Chesham Place, Belgrave Square, London, SW1.

Acton. British Alkaloids Limited. The factory in Atlas Road is to be extended.

Ballymena. G. B. Britten & Sons Limited, Lodge Road, Kingswood, Bristol. Plans have been approved for the erection of a new factory at Paradise Avenue.

Bradford. Haworth & Walter Limited, Handel Street. Foundry extensions.

Blackpool. J. Shepherd & Son Limited. The Windmill Appliance works in Clifton Road are to be extended.

Buxton. Otter Controls Limited, Market Street are to make extensions to their works.

Camberley. Rockweld Limited, Commerce Way, Croydon, considering the erection of a new factory.

Chester. British Insulated Callender's Cables Limited, Norfolk House, Norfolk Street, London, WC2, are to erect a new factory on the Sealand Trading Estate.

Chipping Norton. John Bruce (Engineers) Limited, Eynsham, Oxford are negotiating for a site for a new factory.

Colnbrook, Bucks. Copperad Limited. The architects for factory extensions are Devereux & Davies, 3 Gower Street, London, WC1.

Croydon. A. H. Hunt Limited, Vulcan Way. Factory extensions.

Dundee. National Cash Register Company Limited. The architects for extensions to their works are J. S. Beard, Bennett & Wilkins, 101 Baker Street, London, W1.

Ealing. Paines & Byrne Limited. Extensions are to be made to the factory at Bilton Road, Perivale.

Eire. A. O. Reynolds & Co., Lebanon, Indiana. The architects for the new factory at Birr, Co. Offaly, is H. D. W. Boyd, 28-30 Upper Baggott Street, Dublin.

Enfield. Hunter Vehicles Limited, Southbury Road. Factory is to be extended.

Glasgow. The Cumbernauld Development Corporation, 91 Mitchell Street, is to build two factories at Cumbernauld.

Grangemouth. Muirhead & Sons Limited, are to make extensions to their factory.

Hartlepool. Arosa Hosiery Manufacturing Company Limited. Architects for extensions to the factory are Newrick & Blackbell, 58 John Street, Sunderland.

High Wycombe. Harrison & Sons, Limited. Extensions are to be made to works. The architects are Elliott, Cox & Partners, 172 Buckingham Palace Road, London, SW1.

Kidwelly. Bristol Aerojet Limited, an amalgamation of Bristol Aeroplane Company, Bristol and Aerojet-General Corporation of Azusa, California are to erect a new factory.

New Factories

Kilmarnock. Blackwood, Morton & Sons, Limited. The architects for new factory are H. Dawes & Sons, 40a Portland Street.

Leith. Ralph Symonds (Scotland) Limited (subsidiary of an Australian Company). A new factory is planned at Leith Docks.

Llandudno. The Urban Council propose to develop a light industry estate at Build Street & Builder Street West.

London. Chiswick Products Limited, Great Chertsey Street, London, W4. The architect for extensions is L. Twigg, 3L Bouverie Street, London, EC4.

Maidenhead. Taylowe Limited, Malvern Road, Furze Platt. The architects for extensions are K. Wakeford, Jerram & Harris, 7 Connaught Place, London, W2.

Manchester. Brookside Clothing Company Limited, 30 New York Street, Ardwick. The architect for extensions to the factory at Floats Road, Baguley is K. Newton, The Downs, Altrincham.

Margate. Lines Bros. Limited. Extensions are to be made to the factory at Ramsgate Road.

Market Drayton. Corsets Silhouette Limited, Harlescott Lane, Shrewsbury. Permission has been received for a new factory to be erected.

Nuneaton. Alfred Conner & Co. Limited, Aston Road are to make extensions to their factory.

Ruislip. G. Driver & Son Limited, Abbeydale Road, Wembley are to erect a new factory at Field End Road, The architects are Hucklie & Durkin, 30 Queen Anne Street, London, W1.

Shotts. Cummins Engine Company. The architects for extensions are Gavin Paterson & Son, 147 West Regent Street, Glasgow, C3.

Stockport. Thos. Storey (Engineers) Limited are to have extensions made to their works at Birmingham Road.

Swansea. Bernard Hastie & Co. Limited, 8 Rutland Street. New workshops are to be built at Hafod Isha.

Walthamstow. S. E. Porter & Sons Limited. Extensions are to be made to the factory in Argall Road.

The British Xylonite Company Limited, (Halex Division) are to make extensions to their Larkswood Works, Larks Hall Road.

Watford. B. Walker & Son Limited. Extensions are to be made to the factory in Federal Way.

Willenhall. Josiah Parkes & Sons Limited. The contractors for extensions to Portobello works are Henry Willcock & Co. Limited, Darlington Street, Wolverhampton.

Aberdeen. Abertay Paper Sacks Limited, a subsidiary of C. Davidson and Sons Limited, Mugiemoss, is to build a large new factory at Mugiemoss for manufacture of paper sacks.

Ayr. William C. Gray and Company Limited carpet manufacturers are to erect new storage premises at McCalls Avenue at a cost of £8,500.

John Wallace and Sons (Ayr) Limited are to demolish premises and erect a new agricultural workshop at Smith Street to cost £4,000.

Cumbernauld. The Cumbernauld Development Corporation is planning the erection of a number of advance factories at Cumbernauld.

Dunbar. The Salamander Company (Edinburgh) Limited are to gather seaweed for Norwegian users and are to consider the location of a small factory in this area to process the seaweed in place of shipping it.

Dundee. Bristol Tool and Gauge (Scotland) Limited. This new company will manufacture high precision components and press tools. The warehouse of Thomson Shepherd & Co. Limited at Seafield works is being converted to handle this work and ultimate employment of 100 is expected.

Glasgow. Mine Safety Appliances Limited, Queenslie Estate have doubled their productive capacity since the plant was laid down and have plans on hand for further expansion.

The Playtex factory at Port Glasgow Industrial Estate is to be substantially expanded.

Glenrothes. Five advance factories of 2400 sq ft each will be built by Glenrothes Development Corporation; they will be designed for smaller firms and be suitable for subdivision.

Grangemouth. The Town Development Plan for 10 to 12 factories on the 60 acre industrial estate site on the former airfield has been approved by the Secretary of State for Scotland.

Hawick. Pringle of Scotland Limited are to build a £37,000 extension to the present factory at Teviot Crescent, Hawick.

Inverness. Michael Nairn and Company Limited of Kirkcaldy seek a site in the Holm Mill district for an automatically operated particle board plant using timber thinnings from the Highland area to make boarding for industrial uses.

Irvine. The Irvine Industrial Development Association is organizing factory sites in the town to take small foreign industries into the area. Swedish, Danish, Norwegian, and Finnish firms are among those particularly interested.

Salfords, Surrey. Mullard Research Laboratories at Salfords, near Redhill, Surrey, are being extended, two new blocks being built on an adjacent site. The architects are Norman and Dawbarn.

Simonstone, Lancs. Mullard Limited are to construct a new factory for the production of glass for TV tubes adjacent to their existing factory at Simonstone.

Grangemouth. Union Carbide Limited plan to double their facilities for the production of polyethylene by the provision for another unit at Grangemouth.

CLASSIFIED ADVERTISEMENTS

Situations Vacant

CHIEF ENGINEER

The Walker Chemical Company Ltd. requires a Senior Mechanical Engineer for its manufacturing plants at Bolton and Bury. In addition to assuming responsibility for Plant maintenance services, the successful candidate will be expected to lead a team handling the design and construction of new Plants. Qualifications required are a degree in Mechanical Engineering or A.M.I.Mech.E., with a minimum of five years experience in the Organic Chemical Industry. Excellent salary and conditions. Applications should give full details of age, experience and qualifications and should be addressed to the Managing Director, The Walker Chemical Company Ltd., P.O. Box No. 8, Bolton, Lancs.

UNIVERSITY OE HONG KONG
READERSHIP IN MECHANICAL ENGINEERING

APPLICATIONS are invited for the above post. Applicants must be graduates of a British Commonwealth University or equivalent and must be Corporate Members of the Institute of Mechanical Engineers with teaching experience at university level. Preference will be given to those with special qualifications in Engineering Thermodynamics.

Annual salary (superannuable) is £2,500 (man), or £1,900 (woman) together with an expatriation allowance of £300 a year if applicable. The equivalent of income tax in the Colony is comparatively low.

First-class sea passages are provided for expatriate staff and their families on first appointment and leaves.

Further particulars and information as to the method of application may be obtained from the Secretary, Association of Universities of the British Commonwealth 36 Gordon Square, London, W.C.1.

Applications close, in Hong Kong and London, on **30th June, 1959.**

Machinery, Plant and Accessories For Sale

"FRIGIDAIRE" Low Temperature Refrigerators. 49 in.w × 28 in.d × 34 in.h ext. Ex Large National User, suitable A.C. or D.C. Deep Freezing, Storage of Ice Cream, Frozen Foods, etc. Price £40.0.0 each. Domestic Refrigerators, Service Cabinets and Cold Rooms also available. A.R.C., 134 Great Portland Street, London W1. MUSeum 4480.

FANS! ! ! for Dust, fume extraction, air conditioning, compressors, accessories, motors, etc.; at considerably reduced prices. People say—"If only we'd known of you before. . . . Write for very interesting list. Bellangers, 306 Holloway Road, London N7. North 4117.

PUMPS for all purposes. R. L. Christansen Limited, Wordesley, Stourbridge. Brierley Hill 78184/5.

Patents For Sale or License

THE proprietor of British Patent No. 722922, entitled "Resilient Seal Gate Valves" offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Boulevard, Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 630142, entitled "METHOD AND APPARATUS FOR DISTILLING CARBONACEOUS MATERIAL", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

Classified advertisements are inserted at the rate of 2/9 per line.

THE proprietor of British Patent No. 684356, entitled "Machine and method for stripping hop vines" offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

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THE proprietor of British Patent No. 726707, entitled "ATOMIZING SPRAYER", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.

THE proprietor of British Patent No. 718976, entitled "Improvements in or relating to couplings for rods, tubes and the like", offers same for license or otherwise to ensure practical working in Great Britain. Inquiries to Singer, Stern & Carlberg, 14 E. Jackson Blvd., Chicago 4, Illinois, U.S.A.